LUTHER BURBANK

Two California sonnets sound a knell over the loss of the great naturalist.

O Mother Earth, how couldst thou let him go?
Thy son, whose every touch was a caress
To blossom into all of loveliness,—
This gentle son of thine who loved thee so!
Who lived a gospel humblest souls but know,
And voiced his faith in deeds that live and bless.
Lo, all the treasure of thy veins were less
Than this, the gold such Alchemist may show!
Thou wert almost a heaven beyond compare
To him, wherein he witnessed everywhere
The Maker's handwork in each path he trod
And followed with HIS labor, like to prayer,
What soul has walked within a way more fair?—
A cleaner pathway to a surer God?[1]

—INA COOLBRITH.

[1] Reprinted from *San Francisco Examiner.*

THE gentlest man in all the world is dead—
So understanding in his thought of her
That Nature made him her interpreter,
And crowned him with the sun about his head;
Crowned him with sun, and gave him Love instead
Of human greed; such Love that eyes now blur
With tears, while memory's lavender and myrrh
Breathe in the blossom-pall upon his bed.
He sleeps as gently as he lived; and high
Among the trees, and underneath where blow
The April buds, the green earth seems to know
And grieve—and hush—and softly say:
"Good-bye!"
And all who love him, where the blossoms bend,
Lean low to hear all Nature whisper: "Friend!"[2]

—EDITH DALEY.

[2] Reprinted from *San Jose Mercury Herald.*

LAND OWNERS SHOULD BE LEADERS

You will have noticed, too, that the press both in England and India laid a great stress on the significance of these pronouncements. The leading newspapers in this country have always been true friends of the department and have, from time to time, brought to the notice of their readers the importance of the work which is being done for the betterment of the tiller of the soil. We only hope that in course of time our leading land owners will also realize that the moral and material welfare of this Great Empire is largely dependent on the advancement of agriculture, which provides a livelihood for three out of every four of her people, and which provides as well the materials required for the development of most of her other industries.

But advancement must be based on new knowledge—the foundation of progress in agriculture as in other industries. There is only one way of wresting from Nature this knowledge as to how improvements can be effected, and that is by scientific research. There is a very real danger in these days of the importance of research being lost sight of, and of our demonstrating the same old improvements year after year, for want of anything new to demonstrate. What our department most urgently requires, in short, is the better organization of research and better facilities for training investigators in order to supply the knowledge on which continuous improvement in every branch of agriculture can be based.

Agriculture has not as yet attracted a fair share of the brains, capital and enterprise available in this country and never will, until and unless we get the educated land-owning classes to interest themselves in its development. We only hope that the considered opinion lately expressed by those in authority with respect to the paramount importance of agriculture as the premier industry of India will help towards that end. In the realm of husbandry we want hundreds of leaders of the stamp of Sir Ganga Ram and Mr. Roberts of the Punjab—men of brains, imagination and capital—to raise the standard of agricultural practice to a higher plane and to establish the farming industry on a sound economic basis. But until such men come forward in adequate numbers Government will, in the interests of India, have to provide the driving and organizng power at every stage of advancement.

From an address by Doctor Clouston, *before Board of Agriculture in India.*

OBSERVATIONS ON THE DURATION OF SERVICE AND SERVICEABLE LIFE OF WORK CATTLE[1]

B. M. GONZALEZ
Of the Department of Animal Husbandry

The amount of service one may expect from one's work animals, or more specifically, the length of time one may expect to use work animals is a question of economic interest to a farmer. In the Philippines the investment in work animals forms a considerable proportion of the capital outlay necessary to operate a farm. It would be of practical benefit for the Filipino farmer to know, more or less definitely, the duration of service of animals, as it would enable him to plan his work more intelligently in so far as animal labor supply is concerned, and to adequately charge off to his crops the depreciation of such stock.

Since the foundation of the College of Agriculture in 1909 it has had in use approximately one hundred work animals, all males and, in most all cases, steers. These were numbered consecutively, and the solid block of numbers from 1 to 30 have all died or been disposed of at this writing. The total period of time covered by the observations is 16 years. The writer has participated directly in the disposal of practically all these animals, and can state that the basic reason in all cases where the animals were sold or butchered was that the animals were no longer efficient for work. The usual cause of inefficiency was old age, although in three cases it was due to poor selection in buying the animals, as was manifested later. All the animals were especially selected for work. The writer was responsible for the selection of only one of them.

DISPOSAL

The exact manner of disposal of the thirty animals is summarized herewith:

Sold for butchering or butchered on grounds	21
Donated to Veterinary College for anatomy specimens	3
Died of disease	4
Died from accident	1
Sold as work animal	1
Total	30

The animals sold for butchering or butchered on the grounds were either old animals or animals not suitable for work for one reason or another. Those donated to the Veterinary College were likewise unserviceable animals that

[1] Experiment Station contribution No. 388. Received for publication July 17, 1926.

were old and so spare in flesh that they could not command a reasonable price as butcher animals. The animal sold for work was still usable but was not good enough to stand the steady work demanded of College work animals. The animal that was accidentally killed, fell in a ravine. He was fairly old and had been in the service of the College for seven years and one month, so that he had about completed his term of usefulness, as may be seen later. It is likely that old age was the basic cause of the accident. Of the four animals that died a natural death, two were noted in the autopsy report as having died of senility, one of acute indigestion, and one undetermined, but likely Texas fever; the post-mortem symptoms indicated the latter disease, but the causal organism could not be demonstrated in the blood smears taken.

It may be seen from the above that there was no abnormal cause of mortality, due to epizoötic or some other major cause. It may also be noted that twenty-two out of thirty animals, or 73 per cent, had a cash value for meat after their period of usefulness as work animals was passed. Figures are available on this point; that is, the purchase price and the sale price of each of the animals sold or butchered are on record. Some of the animals were butchered during the war, however, when prices were abnormally high, and their sale price was actually higher than their purchase price. It would therefore be misleading to interpret such figures as representing normal values of discarded work stock sold for beef, hence we shall pass them by.

ORIGIN

The sources from which the thirty animals originated are as follows:

China	8
Indo-China	8
Philippines (Batangas 13; Romblon 1)	14
Total	30

The Chinese animals were low set and blocky, and were excellent work animals with respect to temperament, strength, and disposition for work.

The Indo-Chinese animals were more leggy and less tractable than the Chinese, but fully as strong. They were fair work animals.

The Philippine animals were very similar to the Chinese in conformation. They were strong, fast, and steady workers.

The Chinese and Indo-Chinese oxen were on the whole easier keepers than the Philippine.

SERVICE RECORD OF ANIMALS

Table 1 shows when the animals were purchased, when they were disposed of, and the length of time they were on the grounds. The actual day

of the month was purposely dropped as the circumstances hardly warrant extreme accuracy in the treatment of the figures. For lack of a better figure, the date when the animal was disposed of is taken as the end period of his usefulness. This, of course, is only approximate as the period of degeneration of a work animal is long and gradual.

TABLE 1

Showing the period of service of each animal

HERD NO.	DATE OF PURCHASE	DATE OF DISPOSAL	LENGTH OF SERVICE	REMARKS
Chinese				
1	Feb. 1910	Jan. 1921	10 yrs. 11 mos.	Sold to butcher
2	" "	Nov. 1916	6 " 9 "	Sold to butcher
3	" "	Dec. 1916	6 " 10 "	Butchered
4	" "	Dec. 1919	9 " 10 "	Donated to Vet. College
5	Aug. 1910	March 1917	6 " 7 "	Butchered
6	" "	Jan. 1916	5 " 5 "	Died of senility
7	" "	Oct. 1923	13 " 2 "	Butchered
8	" "	Jan. 1919	8 " 5 "	Butchered
		Average	8.5 years	
Indo-Chinese				
9	June 1912	March 1919	6 yrs. 9 mos.	Sold to butcher
10	" "	Jan. 1919	6 " 7 "	Sold to butcher
11	" "	Jan. 1919	6 " 7 "	Sold to butcher
12	" "	May 1915	2 " 11 "	Died of senility
13	" "	Aug. 1924	12 " 2 "	Sold to butcher
14	" "	March 1919	6 " 9 "	Sold to butcher
15	" "	Nov. 1916	4 " 5 "	Sold to butcher
16	" "	Aug. 1924	12 " 2 "	Sold to butcher
		Average	7.3 years	
Philippine				
17	Sept. 1913	Feb. 1916	2 yrs. 5 mos.	Died of acute indigestion
18	" "	Jan. 1914	0 " 4 "	Died of Texas fever (?)
19	" "	Dec. 1924	11 " 3 "	Butchered
20	" "	July 1916	2 " 10 "	Butchered
21	" "	Feb. 1917	3 " 5 "	Butchered
22	" "	Aug. 1916	2 " 11 "	Butchered
23	Jan. 1916	July 1923	7 " 6 "	Sold as work animal
24	" "	June 1925	9 " 5 "	Sold to butcher
25	" "	June 1923	7 " 5 "	Sold to butcher
26	" "	June 1925	9 " 5 "	Sold to butcher
27	" "	June 1923	7 " 5 "	Sold to butcher
28	" "	Feb. 1923	7 " 1 "	Died from accident
29	" "	Oct. 1923	7 " 9 "	Donated to Vet. College
30	July 1927	Oct. 1924	7 " 3 "	Donated to Vet. College
		Average	6.2 years	

Weighted average for all—7.1 years

It may be seen that the Chinese animals were serviceable for the longest time, the Indo-Chinese next, and the Philippine animals for the shortest time.

These results agree with the general opinion held by men who have had a chance to use these three "breeds" of animals. Personally, we are not inclined to press this conclusion, as an important factor has not been considered in forming the opinion; that is, the age of the animals when they were purchased by the College. This question will be taken up more in detail later.

All these animals had a variety of work during their life time, and since there was never any plan to favor any one group, for as a matter of fact the laborers who used the animals did not know their origin, it is a reasonable assumption that the amount of work performed by each group was fairly uniform.

For the present all we wish to point out is the approximate duration of the serviceable life of work animals purchased in the open market under our working conditions, and this has been found to be 7.1 years.

The working day for work bullocks in the College is approximately seven hours. The laborers bring in the animals from the pasture at 6:00 a. m. and they are generally at work by 7:00 a. m. The animals are unhitched at eleven o'clock, watered and pastured, then hitched up again at one o'clock and worked until four o'clock in the afternoon.

The animals are worked more or less regularly six days a week throughout the year. This was especially true during the early days of the institution when there was a shortage of work animals. On Sundays and holidays and on very rainy days, the animals are usually rested.

The work performed includes the use of single animals to pull small plows, carts, tooth harrows, planters, and cultivators; two animals for disk harrows, larger plows, and the straddling corn cultivator; and three animals for the disk plow and very heavy moldboard plows.

AGE OF ANIMALS AT PURCHASE

There was no accurate way of telling the age of the Chinese and Indo-Chinese bullocks. They were purchased through the Bureau of Agriculture from Manila importers. Judging from their appearance and the rings on their horns, their estimated ages ranged from four to eight years and averaged about six years. This figure is not likely to be in error more than a year or two in either direction.

A very approximate age of the Philippine animals may be obtained from their certificate of registration. There is a law[2] that requires that all large animals in the Philippines be branded before they reach two years old, and in Batangas Province, where practically all the Philippine animals came from, this law is followed, usually, because of the frequency of cattle thieving. A man who owns an unbranded animal is more likely to

[2] Administrative Code of the Philippine Islands of 1917, Act 2711, Sec. 515.

lose it than when it is branded, and if he should subsequently find it, he has little evidence to establish his ownership. And a thief may easily present an unbranded animal for certification and branding in his name. So the law is generally complied with. The age of these animals as it appears in their certificate of ownership is likely to be accurate within one year, and any error to be on the side of making the animal younger. There would be no particular reason for an owner to declare his animal to be older than it really is, while the registration of an animal may be retarded through neglect or purposely because the animal is small for its age, or through the advantage that may be gained by the animal passing for younger than it really is. The age noted, therefore, may actually be less than the real age by about a year in some cases.

Table 2 shows the data for all except one of the Philippine animals. The certificate for this one has been filed elsewhere and cannot be found now.

TABLE 2

Showing the age of Philippine bullocks at the time of purchase

HERD NO.	DATE OF BIRTH		DATE OF PURCHASE		AGE AT PURCHASE	
18	July	1901	September	1913	12 years	2 months
19	April	1907	"	"	6 "	5 "
20	April	1907	"	"	4 "	5 "
21	February	1910	"	"	3 "	7 "
22	July	1908	"	"	5 "	2 "
23	September	1906	January	1916	9 "	4 "
24	August	1906	"	"	9 "	5 "
25	March	1908	"	"	7 "	10 "
26	May	1910	"	"	5 "	8 "
27	October	1909	"	"	6 "	3 "
28	June	1909	"	"	6 "	7 "
29	September	1906	"	"	9 "	4 "
30	November	1911	July	1917	5 "	8 "

Average—7.06 years

It may be noted that the Philippine animals averaged over seven years when purchased. Since Philippine oxen are put to regular work at four years of age, or even earlier, it is obvious that these animals have rendered service averaging three years or better elsewhere. The period of training generally starts when the animals are between two and three years old, but the animals are not worked steadily until about a year later, when they have about completed their growth. Most of these animals were purchased from farmers who used them in their farm work, but tempting prices induced them to sell. This puts their average working life at about ten years.

Assuming that the age at purchase of the Chinese and Indo-Chinese animals to be six years in each case, then the mean life of the three kinds of animals is as follows:

Breed	*Age at purchase years*	*Life in College years*	*Total life years*
Chinese	6	8.5	14.5
Indo-Chinese	6	7.3	13.3
Philippine	7.1	6.2	13.3

The Philippine work ox does not show unfavorably in this table. No conclusion, however, is advanced as the premise on which the figures for the Chinese and Indo-Chinese oxen are based is not very secure.

SUMMARY

1. The average working life of thirty work oxen used at the College of Agriculture was 7.1 years. The approximate age of the above animals when purchased was 6 to 7 years.

2. The approximate average age when these animals were disposed of because no longer serviceable for work, or at which they died natural death, was 13.3 to 14.5 years.

3. As oxen in the Philippines may be trained and used for regular work at the age of four years, the average serviceable life of Philippine oxen under working conditions set out in these observations, may be placed at approximately ten years.

4. Approximately three fourths of the thirty animals included in these observations had a cash value for meat after their period of usefulness as work animals was passed.

PRELIMINARY STUDIES ON THE INSECTICIDAL PROPERTIES OF THREE SPECIES OF DERRIS IN THE PHILIPPINES[1]

NICANOR CASTILLO

WITH ONE TEXT FIGURE

INTRODUCTION

Derris is a leguminous genus composed mainly of tall, woody vines. According to Bailey (1919) some of its species are trees. Merrill (1912) states that there are in all about forty species known, of which twelve are found in the Philippines. The genus, according to the same authority, is native of the Tropics, being more abundant in the Old World than in Tropical America. Its members generally attain a few meters in height and seven to fourteen centimeters in trunk diameter. Numerous branches are produced with the tips hanging downward. In Laguna Province, these plants can be found along the borders of fields where vegetation is little disturbed, by the sides of creeks, rivers, and lakes, and scattered throughout forest areas.

A number of species of this genus are used in the Tropics for stupefying and killing fish. In the Philippines, Bacon (1906) was the first to record *Derris polyantha* Perk. as being used for this purpose. Brown (1921) subsequently reported *D. elliptica* (Roxb.) Benth. and *D. philippinensis* Merrill. Kalaw (1924) added another species, *D. uliginosa* Benth. The method of catching fish with the use of Derris has long been practiced by the fishermen in the Philippines. Recent legislation under Act No. 1499, amended by Act No. 1685, prohibits the use of any poisonous substance or dynamite or other explosives for killing fish.

The importance of Derris as an insecticide has been rapidly gaining recognition in many countries. In the Philippines, practically no attention has been paid to this promising plant in connection with insect control.

Review of literature

The use of Derris as an insecticide was probably suggested to the first investigators by its use in the Orient, particularly in early times, as an arrow poison, then later, as a fish poison and in the control of caterpillars. The earliest written record was apparently the report of Hooker (1877) on

[1] Thesis presented for graduation, 1926, with the degree of Bachelor of Agriculture from the College of Agriculture No. 232; Experiment Station contribution No. 389. Prepared in the Department of Entomology under the direction of Associate Professor L. B. Uichanco. Tentative experiments in connection with this work were originally conducted in the Department of Plant Physiology under the direction of Prof. D. A. Herbert.

Derris elliptica in Singapore. Other reports, including earlier writers, also in the Orient, were Dymock, Warden, and Hooper (1890), Wray (1892), Van Sillevoldt (1899), Power (1902), Watt (1908), Van Hasselt (1911), Wood (1912), Campbell (1916), and Corbett and Yusope (1924). In England, some of the workers were Smith and Wadsworth (1921), Tattersfield and Roach (1922), and Fryer, Stenton, Tattersfield, and Roach (1922), while in the United States reports were published by Howard (1918), McIndoo, Sievers, and Abbott (1919), Parrott, Glasgow, and McLeod (1921), Gilmer (1922), Wells, Bishopp, and Laake (1922), McIndoo and Sievers (1924), and DeOng and White (1924). These names represent only a few of the authors who have published papers on this subject. This list is given to indicate the extent to which investigation has been carried on in various parts of the world.

The foregoing investigators have worked on the following species of Derris:

1. *Derris elliptica* Benth.
2. *Derris uliginosa* Benth.
3. *Derris koolgibberah* Baill.
4. *Derris oligosperma*
5. *Derris scandens* Benth.
6. *Derris robusta* Benth.

Of these species these investigators found that only the first three are effective as an insecticide.

The insects on which experiments were carried were caterpillars, ants, fleas, ticks, mosquito larvæ, aphids, beetles, beetle larvæ, chicken lice, house flies, various phytophagous Hemiptera, and also ectoparasites of domestic animals.

The portion of Derris plants that was used was invariably the root; the other parts have not been found efficient, since apparently the toxic substances are not present there in sufficient quantities. The roots are powdered and are applied either as dust, pure or combined with other ingredients, such as tobacco dust, soot, etc., or in solution. If in solution, the solvent used was either water or alcohol; if the latter, it was subsequently diluted with water.

Experiments were also conducted, especially by Tattersfield and his colleagues in England, in an effort to determine the active principle in Derris. All these investigators seemed to agree that the toxic principle is nitrogen-free, non-glucosidal, non-alkaloid, white crystalline derivative and resin with a melting point of 73° C. The name "tubatoxin" has been applied to this substance by Tattersfield and his co-worker, who claimed it to be identical with "tubain" of Wray (1892) and with "derrid" of Sillevoldt (1899). The last named author gives the chemical formula as $C_{33}\ H_{30}\ O_{10}$.

Object of the present work

The present study was conducted in an effort: (*a*) to determine the optimum concentration of Derris in an aqueous solution to produce the maximum toxic effect against aquatic and against terrestrial insects; (*b*) to determine the duration of toxicity in aqueous solutions; and (*c*) to determine the relative degrees of toxicity of the most easily available species of Derris in the Philippines.

Time and place of the present work

The work was carried on during the college year 1925–1926 at the College of Agriculture, University of the Philippines, Los Baños. This work was begun in June, 1925, and carried on to February, 1926. The experiments were conducted in the Insectary of the Department of Entomology of the College of Agriculture.

MATERIALS AND METHODS

Species used

For the present study three common species of Derris were used.

1. *Derris polyantha* Perk. Tuble (Tag.).
2. *Derris philippinensis* Merr. Gogo-gogoan (Tag.).
3. *Derris elliptica* (Roxb). Benth. Tibanglan (Tag.).

The last two species are abundant on Mount Maquiling, and were obtained through the courtesy of Mr. Mamerto Sulit, a ranger in the Bureau of Forestry. *D. polyantha* was obtained in the barrios of San Vicente, San Bartolome, and San Pablo, municipality of Santo Tomas, Batangas Province, on July 4, 1925. In these localities this species is cultivated in orchards, usually among coconuts and oranges. The identifications were checked by Dr. Eduardo Quisumbing of the Department of Plant Physiology.

The roots were cut into thin transverse slices and then dried in an oven at a temperature of 40° C. until the weight remained fairly constant. The dried material was then comminuted in a mortar and the powdering finally completed in a meat grinder. The fine powder was separated from the fibers by sifting through fine-meshed cloth. From chopping of roots to the finished product, the operation consumed a considerable time—about three months, from June to August, 1925.

DESCRIPTION OF THE EXPERIMENTS

The present experiments are discussed under the following headings. A detailed description of each part is given later.

1. Effect of different concentrations in aqueous solution of *Derris philippinensis* on mosquito larvæ.

2. Comparative studies on the toxicity of three species of Derris in aqueous solution on mosquito larvæ.

3. Effect of different concentrations in aqueous solution of *Derris philippinensis* on *Aphis medicaginis* Koch (Aphididæ).

4. Comparative studies on the toxicity of three species of Derris in aqueous solution on *Aphis medicaginis*.

The choice of the foregoing insects as materials for the present experiments was determined (*a*) largely by the fact that they can be easily secured in abundance; (*b*) they are easily reared under laboratory conditions; (*c*) in the case of mosquito larvæ, at least, conditions in the media in which they live, namely, water, are easily controlled and fairly accurately standardized; (*d*) their economic importance; and (*e*) the contrast between the media in which aphids and mosquito larvæ live, namely, air and water, respectively.

Experiment I

Effect of different concentrations of Derris philippinensis in aqueous solution on mosquito larvæ. After five weeks of preliminary work, experiments were begun on November 7, 1925. Eight lots were used, as follows:

Lot I, control.
Lot II, 0.5 gram in 1000 cc. water.
Lot III, 1 gram in 1000 cc. water.
Lot IV, 2 grams in 1000 cc. water.
Lot V, 3 grams in 1000 cc. water.
Lot VI, 4 grams in 1000 cc. water.
Lot VII, 5 grams in 1000 cc. water.
Lot VIII, 10 grams in 1000 cc. water.

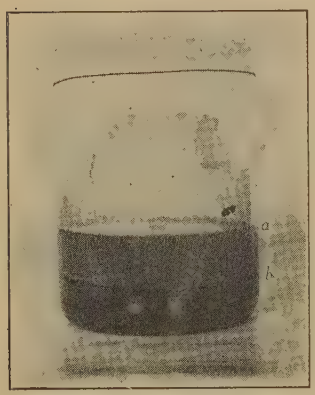

Fig. 1.—Apparatus used in testing effect of Derris on mosquito larvae. (*a*) level of solution; (*b*) cheese cloth strainer.

The apparatus used is illustrated in figure 1. It consists of a battery jar 20.5 centimeters tall and 14.5 centimeters in diameter, covered over the top with cheese cloth. About two centimeters from the bottom, a strainer, also of cheese cloth, was fixed by means of a closely fitting bamboo frame. The object in using this strainer was to let the sediment settle at the bottom of the jar and thus prevent the mosquito larvæ from gaining access to it. This precaution was taken so as to be reasonably sure that whatever toxic effect might be observed on mosquito larvæ was due to water-soluble Derris material and not the result of eating the particles of the powdered roots. As to whether or not any toxic ingredient is left in the sediment after the water-soluble principle has been extracted was not determined in the present experiments. It was the plan to carry this work on as a basis for future investigation.

Known weights of Derris-root powder were added to 1000 cc. of water and thoroughly stirred. The mixtures were then poured into the jars and

after the sediment settled at the bottom, 100 mosquito larvæ were added to each lot. Two series were used in this, as well as in the subsequent experiments, in order to check up the results. The time of beginning the treatment was recorded. The cultures were inspected regularly every hour for the first sixteen hours and once a day thereafter. The time when the first death occurred in each culture and the number of larvæ which died were recorded. After a number or all of the larvæ had died, the jars were uncovered and the surface of the water inspected daily for mosquito eggs. Observations were made also as to larvæ hatching from these eggs. This phase of the work furnished data on duration of virulence of Derris in aqueous solution.

The problems involved in this experiment were: (*a*) To determine the minimum concentration required to produce any observable toxic effect; (*b*) to find the concentration that would kill the larvæ most rapidly; (*c*) to find the concentration which produced the largest percentage of fatality; and (*d*) to find the length of time in which each concentration retained virulence. The results are reported in table 1, Series A and B, and summarized in table 2.

As shown in table 1 and the summary table 2, the optimum concentration is three grams of Derris powder to 1000 cc. of water. When either more dilute or more concentrated than this, the solution becomes less effective. Concentrations, such as 0.5:1000 and 1:1000 had no effect at all, while 2:1000 was only slightly effective. The explanation of Tattersfield, Gimingham, and Morris (1925), who observed almost identical curious results in connection with *Tephrosia vogellii* Hooker probably holds true in the present case. These authors state that "the crystalline particles were large at high strength and therefore only slightly effective; on diluting, the crystals became smaller owing to solubility and their effectiveness increased, while at a certain point the size of the particles reached a minimum and toxicity rose to maximum." They found that, "at a concentration of one per cent, very little toxicity was shown, but on dilution, the toxicity increased to a certain point and then proceeded to decline in a normal way." By way of comparison with the findings here reported, Campbell's results (1916) may be cited here. He found that in *D. elliptica* the concentrations given below killed mosquito larvæ. "0.1 gram in 1000 cc. water, in at least two days; 0.2 gram in 1000 cc. of water, about two days; 1 gram in 1000 cc. of water, one day; 2 grams in 1000 cc. of water, three hours; 100 grams in 1000 cc. of water, one hour."

The mosquito larvæ died very slowly. When about to die, the larvæ first floated almost motionless near the surface of the water. Later on, they sank to the bottom. The toxic principle acted on the larvæ probably both by ingestion through the mouth and also as a result of the gas emitted entering through the breathing tube. Howard (1918) in his investigation of an Oriental species of Derris, says that "it acts both as stomach poison,

when, however, it is effective against only a few insects, and also as a contact insecticide being efficient against a wide range of pests." Mathieu (1920) was of the same opinion and further suggested that "the toxic principle of the tuba root kills insects by acting both as a contact and as a stomach poison." DeOng and White (1924) on the basis of their experiments on various species of Derris concluded that "the active principle of 'derris' acts both as a stomach and as respiratory, or tracheal poison." McIndoo, Sievers, and Abbott (1919) held the view that the toxic principle "kills some insects easily, and others with difficulty, but usually also slowly and seems to kill by motor paralysis."

One day after removing the covers from the battery jars four batches of eggs were found in lot II, 0.5:1000; one batch of eggs in lot V, 3:1000; and ten batches of eggs in lot VIII, 10:1000. In all the lots the batches of eggs hatched, but in higher concentrations, from 3:1000 to 10:1000, very few larvæ emerged to adults; most of them had died. This is to be expected, since apparently the gradual deterioration and consequent weakening of the toxic principle eventually tended to bring the concentrations down to the optimum level. All of these last mentioned concentrations retained their virulence for practically the same length of time. The fact should be emphasized, moreover, that the optimum concentration of 3:1000 exhibited the same degree of retention of virulence as the higher concentrations.

Concentration of 1:1000 showed a certain degree of toxicity, killing 19 per cent of the larvæ in five days. As shown in the control, only 2 per cent of the larvæ died in that length of time.

Experiment II

Comparative studies on the toxicity of three species of Derris in aqueous solution on mosquito larvæ. This experiment was begun on November 30, 1925. The principal objects were: (*a*) to determine which of the three species of Derris was the most effective; (*b*) to find which species killed the larvæ most rapidly; and (*c*) to determine the length of time each species retained virulence. The results are given in table 3, series A and B, and summarized in table 4. A concentration of 3:1000, which was found as the optimum in experiment I, was adopted as the standard in the present experiment. The arrangement of the apparatus, preparation of the solution, and treatment of insects was similar to that in experiment I. Four lots were used as follows:

Lot I, control.

Lot II, 3 grams of *D. elliptica* powder in 1000 cc. water.

Lot III, 3 grams of *D. philippinensis* powder in 1000 cc. water.

Lot IV, 3 grams of *D. polyantha* powder in 1000 cc. water.

TABLE 1 (Series A)

Comparative tests on the toxicity of different concentrations of Derris phil

DATE 1925	LOT I CONTROL			LOT II 0.5:1000			LOT III 1:1000			LOT IV 2:1000			LOT V 3:1000		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	
7—XI	Experiments started														
8—XI	1	0	0	2	0	0	5	0	0	5	0	0	6	0	
9—XI	0	0	2	0	0	5	6	1	0	11	2	0	30	10	
10—XI	0	0	6	0	0	2	2	0	1	20	5	0	33	15	
11—XI	0	0	2	0	0	1	5	0	4	6	0	0	All dead Uncovered		
12—XI	0	0	4	0	0	7	0	0	14	0	0	5	1 batch of eggs		
13—XI	0	0	1	0	0	10	1	0	10	0	0	12	4 batches of eggs and larvæ		
14—XI	0	0	3	0	0	6	0	0	4	0	0	7	7 batches of eggs and larvæ Covered		
15—XI	1	0	1	0	0	4	0	0	4	Uncovered All pupated			"		
16—XI	0	0	0	0	0	2	0	0	5	1 batch of eggs			"		
17—XI	0	0	1	0	0	0	0	0	3	4 batches of eggs and larvæ			"		
18—XI	0	0	0	1	0	4	0	0	5	6 batches of eggs and larvæ Covered			"		
19—XI	0	0	0	0	0	1	0	0	8	"			"		
20—XI	Uncovered			Uncovered			Uncovered			"			"		
21—XI	3 batches of eggs			2 batches of eggs			3 batches of eggs			"			"		
22—XI	4 batches of eggs and larvæ Covered			5 batches of eggs and larvæ Covered			4 batches of eggs and larvæ Covered			"			"		
23—XI	"			"			"			"			"		
25—XI	"			"			"			"			Adults emerged		
27—XI	"			"			"			"					
29—XI	"			"			"			Adults emerged					
1—XII	"			"			"								
3—XII	"			Adults emerged			Adults emerged								
4—XII	Adults emerged														

Column a—Number of dead larvæ.
Column b—Number of dead pupæ.
Column c—Number of adults which subsequently emerged.

TABLE 1 (Series B)

Comparative tests on the toxicity of different concentrations of Derris philip

DATE 1925	LOT I CONTROL			LOT II 0.5:1000			LOT III 1:1000			LOT IV 2:1000			LOT V 3:1000		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
7—XI	Experiments started														
8—XI	0	0	0	3	0	0	7	0	1	11	0	0	12	0	0
9—XI	0	0	0	0	0	0	8	0	0	16	0	0	35	9	0
10—XI	0	0	6	0	0	6	23	1	1	31	0	0	36	7	0
11—XI	0	0	1	0	0	1	5	0	2	6	0	0	All dead Uncovered		
12—XI	2	0	4	0	0	2	0	0	5	0	1	0			
13—XI	0	0	5	0	0	4	0	0	10	0	0	12	3 batches of eggs		
14—XI	0	0	2	0	0	3	0	0	8	0	0	6	3 batches of eggs and larvæ		
15—XI	0	0	1	0	1	2	0	0	5	0	1	6	7 batches of eggs and larvæ Covered		
16—XI	0	0	1	0	0	2	0	0	1	4 batches of eggs			"		
17—XI	0	0	0	0	0	2	0	0	1	4 batches of eggs and larvæ			"		
18—XI	0	0	0	0	0	0	0	0	2	7 batches of eggs and larvæ Covered			"		
19—XI	0	0	0	0	0	0	Uncovered			"			"		
20—XI	0	0	1	0	0	2	1 batch of eggs			"			"		
21—XI	0	0	2	0	0	2	3 batches of eggs and larvæ Covered			"			"		
22—XI	Uncovered			Uncovered			"			"			"		
23—XI	2 batches of eggs			2 batches of eggs			"			"			"		
24—XI	3 batches of eggs and larvæ Covered			4 batches of eggs and larvæ Covered			"			"			"		
25—XI	"			"			"			"			"		
27—XI	"			"			"			"			"		
29—XI	"			"			"			"			"		
1—XII	"			"			"			"			"		
3—XII	"			"			Adults emerged			Adults emerged			Adults emerged		
5—XII	Adults			Adults											

Column a—Number of dead larvæ.
Column b—Number of dead pupæ.
Column c—Number of adults which subsequently emerged.

TABLE 2

Summary of table 1 series A and B

	LOT I CONTROL	LOT II 0.5:1000	LOT III 1:1000	LOT IV 2:1000	LOT V 3:1000	LOT V 4:1000
Length of time requires to poison larvæ		5 days	5 days	5 days	4 days	4 da
Percentage of deaths	2	3	19	41	100	100
Time required for reinfection	1 day	1 day	1 day	1 day	1 day	1 da

TABLE 3 (Series A)

Comparative tests on the toxicity of different species of Derris on mosquito larvæ

DATE, 1925	LOT I CONTROL			LOT II D. ELLIPTICA 3:1000			LOT III D. PHILIPPINENSIS 3:1000			LOT IV D. POLYANTHA 3:1000
	a	b	c	a	b	c	a	b	c	
30—XI	Experiments started									
1—XII	0	0	0	10	0	0	8	0	0	All dead Uncovered
2—XII	0	0	0	20	3	0	28	2	0	"
3—XII	1	0	1	28	5	0	35	10	0	"
4—XII	1	0	1	19	3	0	15	0	0	"
5—XII	0	0	2	8	0	0	All dead Uncovered			"
6—XII	0	0	0	2	0	0	"			"
7—XII	0	0	1	All dead Uncovered			2 batches of eggs			"
8—XII	0	0	2	"			2 batches of eggs and larvæ			"
9—XII	0	0	2	3 batches of eggs			"			"
10—XII	0	0	3	5 batches of eggs and larvæ			4 batches of eggs and larvæ			"
11—XII	0	0	4	7 batches of eggs and larvæ Covered			5 batches of eggs and larvæ Covered			"
12—XII	0	0	2	"			"			"
13—XII	0	0	7	"			"			1 batch of eggs
14—XII	0	0	5	"			"			"
15—XII	0	0	3	"			"			"
16—XII	Uncovered			"			"			"
17—XII	1 batch of eggs			"			"			Covered
18—XII	3 batches of eggs and larvæ			"			"			"
19—XII	"			"			"			"
20—XII	Covered			"			"			"
21—XII	"			"			Adults emerged			"
22—XII	"			"						"
23—XII	"			Adults emerged						"
24—XII	"									"
25—XII	"									"
26—XII	"									"
27—XII	"									Adults emerged
30—XII	Adults emerged									

Column a—Number of dead larvæ.
Column b—Number of dead pupæ.
Column c—Number of adults which subsequently emerged.

TABLE 3 (Series B)

Comparative tests on the toxicity of different species of Derris on mosquito larvæ

DATE, 1925	LOT I CONTROL			LOT II D. ELLIPTICA 3:1000			LOT III D. PHILIPPINENSIS 3:1000			LOT IV D. POLYANTHA 3:1000
	a	b	c	a	b	c	a	b	c	
30—XI	Experiments started									
1—XII	2	0	0	12	0	0	10	0	0	All dead Uncovered
2—XII	1	0	0	20	0	0	25	0	0	"
3—XII	0	0	0	16	5	0	28	6	0	"
4—XII	0	0	0	10	0	0	20	0	0	"
5—XII	0	0	0	9	0	0	All dead Uncovered			"
6—XII	1	0	0	11	2	0	2 batches of eggs			"
7—XII	0	0	0	5	0	0	2 batches of eggs and larvæ			"
8—XII	0	0	0	6	0	0	"			"
9—XII	1	0	0	All dead Uncovered			4 batches of eggs and larvæ Covered			"
10—XII	0	0	0	3 batches of eggs			"			"
11—XII	0	0	0	5 batches of eggs			"			"
12—XII	0	0	0	"			"			"
13—XII	0	0	0	Covered			"			"
14—XII	0	0	0	"			"			"
15—XII	Uncovered			"			"			"
16—XII	2 batches of eggs			"			"			1 batch of eggs
17—XII	3 batches of eggs and larvæ			"			"			1 batch of eggs and larvæ
18—XII	Covered			"			"			"
19—XII	"			"			"			"
22—XII	"			"			Adults emerged			"
23—XII	"			Adults emerged						"
25—XII	"									"
27—XII	"									"
29—XII	Adults emerged									"
31—XII										Adults emerged

Column a—Number of dead larvæ.
Column b—Number of dead pupæ.
Column c—Number of adults which subsequently emerged.

TABLE 4

Summary of table 3 series A and B

	LOT I CONTROL	LOT II D. ELLIPTICA 3:1000	LOT III D. PHILIPPINENSIS 3:1000	LOT IV D. POLYANTHA 3:1000
Length of time required to poison larvæ		7 to 9 days	5 days	1 day
Percentage of deaths	4	100	100	100
Time required for reinfection	1 day	1 to 2 days	1 to 2 days	13 to 16 days

From tables 3 and 4 it may be seen that *D. polyantha*, is the most effective. In this lot, 100 per cent of the larvæ died after one day; while with *D. philippinensis*, it required five days; with *D. elliptica*, seven to nine days to kill all the larvæ.

The lots were uncovered after the larvæ died. After one to two days, batches of eggs could be found on the surface of the water of lot II, *D. elliptica*, and lot III, *D. philippinensis*, while in lot IV, *D. polyantha*, batches of eggs were not observed until after thirteen to sixteen days. These data indicate, that *D. polyantha* retains its virulence longest—about thirteen to sixteen times as long as either of the other two species. Moreover, most of the eggs laid on lot IV failed to produce adults or even larvæ, while the other two lots did not seem to interfere with the normal development of the insects therein.

Experiment III

Effect of different concentrations in aqueous solution of D. philippinensis on Aphis medicaginis Koch. This work was begun on January 20, 1926. The objects of this experiment were as follows: (*a*) to determine the minimum aqueous concentrations that would produce any observable toxic effect as a contact spray on insects, such as aphids; (*b*) to find the concentration that would give the quickest results; and (*c*) to determine the concentration that, in the long run, would kill the largest number of aphids.

The following lots were used:

Lot I, control.

Lot II, 0.5 gram in 1000 cc. water.

Lot III, 1 gram in 1000 cc. water.

Lot IV, 2 grams in 1000 cc. water.

Lot V, 3 grams in 1000 cc. water.

Lot VI, 4 grams in 1000 cc. water.

Lot VII, 5 grams in 1000 cc. water.

As material for this experiment, small cowpea plants (*Vigna sinensis* Endl., Leguminoseæ) infested with *Aphis medicaginis* Koch were collected from the field and the roots submerged in water in wide-mouthed bottles of con-

venient sizes. The mouths of the bottles were plugged with cotton for the double purpose of keeping the plants firmly in position and preventing aphids from getting into the water and drowning.

Derris was applied on the aphids in the form of aqueous suspension with the aid of a small tin atomizer. Precaution was taken not to hold the spraying apparatus too close to the plant, lest the force of the spraying liquid dislodge the aphids. Just enough of the spraying mixture was applied to moisten the insects. Only one application was made. For the first twelve hours, the cultures were inspected every hour after treatment, then once a day. The results are recorded in table 5, series A and B, and summarized in table 6.

As shown in tables 5 and 6, the concentration that killed the greatest number of aphids was 4:1000. This concentration was found to kill the aphids much more quickly than either the weaker or the stronger concentrations. The weakest concentration used in the present experiments, 0.5:1000, was found to cause death of some aphids.

The effect of Derris on aphids is relatively slow, death being observable only after the lapse of at least twenty-four hours. Some aphids died on the plant without falling. Others fell, remained motionless, and finally died.

Experiment IV

Comparative studies on the toxicity of the three species of Derris in aqueous solution on Aphis medicaginis Koch. A concentration of 4:1000 was adopted as the standard solution in the present experiment. The three species previously reported; namely, *elliptica, polyantha,* and *philippinensis,* were used. The same procedure as in experiment III was followed. The different lots consisted of:

Lot I, control.
Lot II, 4 grams of *D. elliptica* powder in 1000 cc. water.
Lot III, 4 grams of *D. philippinensis* powder in 1000 cc. water.
Lot IV, 4 grams of *D. polyantha* powder in 1000 cc. water.

TABLE 5 (Series A)

Comparative tests on the toxicity of different concentrations of D. philippinensis on aphids

DATE, 1926	LOT I CONTROL		LOT II 0.5:1000		LOT III 1:1000		LOT IV 2:1000		LOT V 3:1000		LOT VI 4:1000		LOT VII 5:1000	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b
20—I.....	Experiments started													
21—I.....	Many	4	Many	11	Many	19	Many	23	Many	30	Many	34	Many	28
22—I.....		4		9		18		25		26		38		23
23—I.....		5		11		18		21		19		30		19
24—I.....		2		4		1		5		6		6		5
Total dead...		15		35		56		74		81		108		75

Column a—Number of aphids treated.
Column b—Number of dead aphids.

TABLE 5 (Series B)

Comparative tests on the toxicity of different concentrations of D. philippinensis on aphids

DATE, 1926	LOT I CONTROL		LOT II 0.5:1000		LOT III 1:1000		LOT IV 2:1000		LOT V 3:1000		LOT VI 4:1000		LOT VII 5:1000	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b
20—I.....	Experiments started													
21—I.....	Many	3	Many	5	Many	18	Many	22	Many	24	Many	44	Many	32
22—I.....		4		20		33		28		38		40		32
23—I.....		1		7		9		9		10		11		15
24—I.....		0		1		5		10		9		16		7
Total dead...		8		33		65		69		81		111		86

Column a—Number of aphids treated.
Column b—Number of dead aphids.

TABLE 6

Summary of table 5 series A and B

	LOT I CONTROL	LOT II 0.5:1000	LOT III 1:10000	LOT IV 2:1000	LOT V 3:1000	LOT VI 4:1000	LOT VII 5:1000
Total number of aphids dead (series A and B).....	23	38	121	143	162	219	161

The results are presented in table 7, series A and B, and summarized in table 8.

TABLE 7 (Series A)

Comparative tests on the toxicity of different species of Derris on aphids

DATE, 1926	LOT I CONTROL		LOT II D. ELLIPTICA 4:1000		LOT III D. PHILIPPINENSIS 4:1000		LOT IV D. POLYANTHA 4:1000	
	a	b	a	b	a	b	a	b
3—II.....	Experiments started							
4—II.....	Many	5	Many	12	Many	14	Many	97
5—II.....		3		23		33		292
6—II.....		4		26		45		310
Total dead.....		12		61		92		699

Column a—Number of aphids treated.
Column b—Number of dead aphids.

TABLE 7 (Series B)

Comparative tests on the toxicity of different species of Derris on aphids

DATE, 1926	LOT I CONTROL		LOT II D. ELLIPTICA 4:1000		LOT III D. PHILIPPINENSIS 4:1000		LOT IV D. POLYANTHA 4:1000	
	a	b	a	b	a	b	a	b
3—II.....	Experiments started							
4—II.....	Many	7	Many	23	Many	28	Many	115
5—II.....		4		46		72		310
6—II.....		9		27		40		255
Total dead.....		20		96		140		680

Column a—Number of aphids treated.
Column b—Number of dead aphids.

TABLE 8

Summary of table 7

	LOT I CONTROL	LOT II D. ELLIPTICA 4:1000	LOT III D. PHILIPPINENSIS 4:1000	LOT IV D. POLYANTHA 4:1000
Total number of aphids dead (series A and B)...	16	157	232	1379

The species that showed the highest degree of toxicity was *D. polyantha*. As shown in table 8, in lot IV, *D. polyantha*, the total number of dead aphids after three days was 1,379; in lot III, *D. philippinensis*, after three days, only 232; in lot II, *D. elliptica*, after three days, 157.

SUMMARY AND CONCLUSIONS

1. The present paper represents the first written report of the use of Derris as an insecticide in the Philippines.

2. The toxic properties of various species of Derris has been recognized for a long time by Filipinos, who until in recent years pounded the roots and used the powder as fish poison. At least one species is found in cultivation.

3. Of the forty species of Derris known, twelve are found in the Philippines. Of this number in this country, apparently only a few have the toxic principle present in sufficiently large quantities to make them useful, as shown by the fact that they are the only species used as fish poison.

4. According to the investigations of other workers, the toxic principle is nitrogen-free, non-glucosidal, non-alkaloid, white crystalline derivative and resin with a melting point of 73°C. The name "tubatoxin" has been applied to this substance by Tattersfield and Roach (1922) who claimed it to be identical with "tubain" of Wray (1892) and with "derrid" of Sillevoldt (1899). The last named author gives the chemical formula as $C_{33}H_{30}O_{10}$.

5. Three species of Derris have been used in the present investigations, namely *D. polyantha* Perk., *D. philippinensis* Merr., and *D. elliptica* (Roxb.) Benth.

6. In the comparative studies of the effect of various concentrations, *D. philippinensis* was used as material, on account of its being relatively more abundant, hence, more easily procurable than the others.

7. Insects of two types of habitat were used; namely, an aquatic insect, mosquito larvæ, and an aërial insect, *Aphis medicaginis* Koch (Aphididæ).

8. The most effective concentrations of *D. philippinensis* on mosquito larvæ in the way of bringing about the highest percentage of deaths in the quickest time was 3:1000.

9. Solutions which were either more dilute or more concentrated than 3:1000 were found less effective than this solution.

10. Concentrations of 1:1000 killed 19 per cent of the larvæ; lower concentrations showed no effect at all.

11. A concentration of 3:1000 or higher retained for from thirteen to sixteen days its toxicity against mosquito larvæ. Concentration higher than 3:1000, presumably became effective later, as a result of deterioration and consequent lowering of the percentage of the toxic principles present.

12. The concentration of *D. philippinensis* which was found most effective against aphids in the way of bringing about the largest number of deaths was much higher than that required for mosquito larvæ; namely, 4:1000.

13. The lowest concentration of *D. philippinensis* used, 0.5:1000, caused a noticeable percentage of mortality among aphids, as compared with the control.

14. In the case of both mosquito larvæ and aphids, *D. polyantha* was found to be more effective than either of the two. In both cases, in aqueous solutions, it showed its superiority in, (*a*) bringing about the highest percentage of deaths, (*b*) the short time it required to kill, and (*c*) the retention of its virulence.

15. *D. polyantha* retained its virulence in water and was toxic to mosquito larvæ for a period ranging from thirteen to sixteen days: *D. elliptica* and *D. philippinensis* for only one to two days.

LITERATURE CITED

Bacon, R. F. 1906. Fish poison used by the natives. Philippine Jour. Sci. **1**: 1025–1029.

Bailey, L. H. 1919. Standard cyclopedia of horticulture. 3rd ed., **2**: pp. 603–1200, 770 fig. New York: The Macmillan Company.

Brown, W. H. 1921. Poisonous Philippine plants. Philippine Bur. Forestry Bull. 22: 79.

Campbell, I. A. 1916. An experimental investigation concerning the effects of "tuba" (D. elliptica) fish poison. Straits Branch Royal Asiatic Soc. Jour. **73**: 129–137.

Corbett, G. H., and M. Yusope. 1924. Scotinophara coarctata, F. (the black bug of padi). Malayan Agric. Jour. **12**: 91–106. Pl. 1. *Cited in* Rev. Applied Entomol., Series A: Agric. **12**: 362. London. 1924.

DeOng, G. H., and L. T. W. White. 1924. Further studies of Derris as an insecticide. Jour. Econ. Entomol. **18**: 499–501. *Cited in* Rev. Applied Entomol. Series A: Agric. **12**: 472. London. 1924.

Dymock, William, C. J. H. Warden, and D. Hooper. 1890. Pharmacographia indica. **1**: London. *Cited in* Jour. Agric. Res. **17**: 177–200. 1919.

Fryer, C. T., R. Stenton, F. Tattersfield, and W. A. Roach. 1922. Quantitative study of insecticidal properties of D. elliptica (tuba root). Ann. Applied Biol. **10**: 18–34.

Gilmer, P. M. 1922. Derris as a parasiticide. From 19th Report State Entomologist Minnesota (typewritten copy).

Greshoff, M. 1890. Mittheilungen aus dem chemisch-pharmakologischen Laboratorium des Botanischen Gartens zu Buitenzorg (Java). Ber. Deut. Chem. Gesell. **23**: 3537–3550. *Cited in* Jour. Agric. Res. **17**: 177–200. 1919.

Hasselt, E. H. Van. 1911. Uber die physiologische Wirkung von Derrid, Pachyrrhizid und Nekoe. Arch. Internat. Pharm. et Ther. **21**: 243–279. *Cited in* Jour. Agric. Res. **17**: 177–200. 1919.

Hooker, J. D. 1878. Report on the progress of the Royal Gardens at Kew, 1877, p. 53, 1 fig. *Cited in* Jour. Agric. Res. **17**: 177–200. 1919.

Howard, L. O. 1918. Report of the entomologist, U. S. Dept. Agric. Bur. Entomol., Wash., D.C., p. 24. *Cited in* Rev. Applied Entomol. Series A. Agric. **7**: 101. 1919.

KALAW, M. M., AND F. M. SACAY. 1925. Some alleged Philippine poison plants. The Philippine Agriculturist **14:** 421–427.

MATHIEU, E. 1920. Tuba root (D. elliptica) as an insecticide. The Gardens' Bull. Straits Settlements **2:** 192–195.

MCINDOO, N. E., A. F. SIEVERS, AND W. S. ABBOTT. 1919. Derris as an insecticide. Jour. Agric. Res. **17:** 177–200.

MCINDOO, N. E., AND A. F. SIEVERS. 1924. Plants tested or reported to possess insecticidal properties. U. S. Dept. Agric. Bull. **1201:** 61. *Cited in* Rev. Applied Entomol., Series A: Agric. **12:** 244. London. 1924.

MERRILL, E. D. 1912. Flora of Manila. 1st ed., 490 pp., Manila: Bureau of Printing.

PAMMEL, L. H. 1911. Manual of poisonous plants. 1st ed., vi+977 p., 458 fig. Iowa: The Torch Press, Cedar Rapids.

PARROTT, P. J., H. GLASGOW, AND G. F. MCLEOD. 1921. Control of apple red bug by dusting. New York Agric. Expt. Sta., Geneva, Bull. **490:** 30, 5 pl. *10: Cited in* Rev. Applied Entomol. Series A: **10:** 364. London. 1922.

POWER, F. B. 1902. The chemistry of the stem of Derris uliginosa Benth. an eastern fish poison. Pharm. Arch., **5:** 145–160. *Cited in* Jour. Agric. Res. **17:** 177–200. 1919.

P. V. 1924. Insecticides végétaux d'Extrême Orient (Derris elliptica et D. uliginosa). Bull. Econ. Indochine **28:** 255–257. *Cited in* Rev. Applied Entomol., Series A: Agric. **12:** 521. London. 1924.

SILLEVOLDT, H. E. TH. VAN. 1899. Über das Derrid und Pachyrhizid, ein Beitrag zur Kenntnis der indischen Fischgifte. Arch. Pharm., Bd. *237:* 595–616. *Cited in* Jour. Agric. Res. **17:** 177–200. 1919.

SMITH, K. N., AND J. T. WADSWORTH. 1921. The carrot and onion flies. Some preliminary attempts at their control. Fruit-grower, Fruiterer, Florist, and Gardener, **1322:** 575–578 and **1323:** 616–618. 13 figs. *Cited in* Rev. Applied Entomol., Series A, **10:** 50. London. 1922.

TATTERSFIELD, F., AND W. A. ROACH. 1922. The chemical properties of D. elliptica (tuba root). *Cited in* Ann. Applied Biol. **10:** 1-17.

TATTERSFIELD, F., C. T. GIMINGHAM, AND H. M. MORRIS. 1925. Studies of contact insecticides. Ann. Applied Biol. **12:** 64.

WATT, G. 1908. The commercial products of India. 1st ed., viii+1189 p., London and Aylesbury: Hazell, Watson, and Viney.

WELLS, R. W., T. C. BISHOPP, AND E. W. LAAKE. 1922. Derris as a promising insecticide. Jour. Economic Entomol. **15:** 90–95.

WOOD, W. L. 1912. Tuba root. Agric. Bull. Malay States, **1:** 164–166.

WRAY, L., JR. 1892. On the Malayan fish poison called Aker Tuba D. elliptica. Pharm. Jour. and Trans. **52:** 61–62.

A BRIEF STUDY OF PRACTICES IN VOGUE IN THE CULTURE OF RICE AND FIELD LEGUMES IN ILOCOS NORTE[1]

PEDRO A. RODRIGO
Of the Department of Agronomy

This study was conducted during the summer of 1926. The survey covered the municipalities of Batac, Vintar, and Bacarra; the first named representing the southern part of Ilocos Norte, and the last two, the central part. The northern part of the province was not visited but according to reliable information the practices in vogue in the two sections visited are identical with those of the north. Most of the time was spent in the municipality of Batac where some actual determinations on yield of rice and mungo were made.

The objects of the study were: (*a*) to obtain first-hand information about the methods of the agricultural practices in Ilocos Norte; and (*b*) to study the method under which rice and field legumes are cultured.

RICE

The most important crop of the province is rice (*Oryza sativa*). Practically all areas in the valleys and in the plains where water stands for some time during the rainy season are devoted to the culture of lowland rice. Upland rice is grown to a limited extent in cainĝin, called in the vernacular *uma*. The type of rice grown in Ilocos Norte is the bearded rice, commonly called the Ilocano rice.

In the rice sections in the central part of the province, in the municipalities of Laoag, Bacarra, Pasuquin, Sarrat, Vintar, Piddig, Solsona and Dingras, there are good irrigation systems. The rice varieties grown in these places mature generally within six and eight months. These towns have good sources of irrigation water, the Laoag and the Bacarra rivers. For the Vintar Irrigation project which was completed in May, 1926, and which will supply irrigation water for Sarrat, Vintar, Laoag, Pasuquin and Bacarra, the source of supply is the Bacarra River. For the Dingras Irrigation project the source of supply is the Laoag River.

The southern part of the province comprising the municipalities of Badoc, Currimao, Paoay, Batac and San Nicolas belongs to the drier section of the province. The rice fields of these municipalities have no reliable source of water. The seasonal rainfall is the main source of the water supply, although a great many temporary irrigation systems have been constructed by the farmers from brooks and creeks by co-operative labor.

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Very often, however, these irrigation systems can not supply enough water to mature the crop, especially when the seasonal rainfall stops as early as the months of September and October. The certainty of water supply for rice fields in the small valleys is generally greater than for those in the plains.

Owing to the lack of a source of water that can be depended upon, the rice crop in southern Ilocos Norte has not been satisfactory, especially during the last few years. While, commonly, the rice plants have a good start, they often fail to produce a good crop because of shortage of irrigation water to mature the grain. The supply of irrigation water has long been a problem of the farmers of this region, especially in Batac where many of the small irrigation dams were washed away by floods some years ago. About four years ago the writer suggested to some farmers of Batac the planting of early maturing varieties (four to four and one-half month varieties) instead of the five to seven month varieties that they were growing before the dams were washed away. But these farmers were prejudiced against early maturing varieties as they believe they do not produce as much as the late maturing ones. But there seems no better solution of this drought problem than the planting of earlier maturing varieties. The rainy months are confined to June, July, August, and September, sometimes extending to October and November. If this natural rainfall is not supplemented by irrigation water, it is impossible to get a good crop with a five to six month variety. In Batac some farmers are now beginning to use early varieties and their results are encouraging. Another advantage in using early varieties is that the crop can be harvested while the soil is still moist and thus it can be prepared for other crops, such as legumes, tobacco, and corn.

Planting

The seed bed, which is generally located upland and where the soil is rich, is prepared as soon as the first rain comes in May or June. The seed is planted in the last half of June, the *bacal* method of sowing being employed. Beds of about one and one-half meters in width and of indefinite length are thoroughly prepared with plow and harrow. The seed is sown in hills, the planter making the holes with one hand and dropping the seed with the other. From about 10 to 30 seeds are sown in a hole. Holes are spaced about 10 to 15 centimeters apart each way. The planted holes are automatically covered when new ones are made. Two planters generally work side by side in a bed, moving forward as they plant.

When the season is normal, the rice paddies are ready for planting about the second week of July or even earlier, that is, when the seedlings are about a month old. The transplanting period lasts till about the end of August. But there are times when the rice paddies can not be prepared early because of late rain or lack of irrigation water. In this event the

seedlings can not be transplanted at the proper time or age. Planting seedlings that are too old is one cause of low production, as old seedlings can not produce as many tillers as young ones. And even when of proper age, rice transplanted after the last of August can not produce a good crop. The usual age of the rice seedlings when transplanted in Ilocos Norte is from four to six weeks, and the best time to transplant is during July and the first half of August.

The seedlings are pulled up from the seed bed usually a day or two before the day set for transplanting. They are tied into small bundles and the adhering soil washed off thoroughly. The bundles may be left in the water or put under the shade until they are taken to the rice fields.

Preparation of rice paddies

The rice paddies in Ilocos Norte, as in other sections of the Islands, are small. The greatest drawback, however, lies in the construction of the dikes. While they are permanently built, they are very narrow and so low that they can not hold a proper amount of water in the paddy. It is not uncommon to see rice paddies even during the rainy days with only about two to four centimeters depth of water, a condition most conducive to the growth of weeds. Much could be done towards the improvement of the rice crops by improving the dikes.

About the end of June and the first part of July the rice paddies are fairly well saturated with water. Plowing, the first step in the preparation of the land, is then done. Before plowing, an implement called *pasaratsat* is passed over the paddy. This is an implement like a planker with tines of sharp knives set in a slanting position about 20 to 25 centimeters apart. The object of this operation is to cut the weeds and the surface soil into slices, thus facilitating the process of plowing. The paddy is plowed to a depth of about 10 centimeters and but once. After plowing, the paddy is harrowed two or three times with a native harrow (*palpal*) made of bamboo. Then the field is left flooded for about two or three weeks during which time most of the weeds decay. The field is then given the final preparation with the *suyod* and the *paragus*. The *suyod* is used to puddle and level the ground and the *paragus* to push the weeds down into the mud.

While the farmer knows by experience that clean paddies and those plowed during the summer are easier to prepare for planting rice, yet he does not take advantage of this knowledge. The paddies plowed during the summer are infested by weeds, mostly *Cyperus difformis*. The farmer's experience has taught him that fields that are weedy during the tilling of the soil are less subject to weed infestation when planted, thus giving the young plants a better chance for a more vigorous start. The decaying organic matter, possibly, is partly responsible for this good growth.

Transplanting

The method of transplanting rice in Ilocos Norte is typical of the Orient. The custom of providing a guitar player as is done in the Tagalog regions is not followed. Men, women, and children are employed in transplanting rice. In the Tagalog regions the planter drains the paddy before transplanting, but this is not done in Ilocos Norte. The planter prefers to have the soil covered with water to a depth of about two to four centimeters, which is too shallow to float the transplanted seedling. The water facilitates transplanting by keeping the seedlings and the planter's hand free from mud. When the seedling is more than 30 centimeters high, it is generally pruned back to this height. Seedlings from a well drained bed are much easier to transplant than from a poorly drained bed, as they have shorter roots.

The seedlings are set from 20 to 25 centimeters apart each way with from one to five seedlings to a hill, depending upon the vigor of the seedlings. There is a tendency in poor soils, and when the variety is early maturing, to plant thicker. In the Batac Farm School, the result on spacing of transplanted rice as practiced in this College was tried in 1925. The spacing was more than 30 centimeters each way with three to five seedlings to a hill. At first the trial provoked adverse criticism among the farmers of the locality and even among the town officials, but when the crop was harvested criticism changed to surprise. Both farmers and officials were much impressed by the outcome of the trial. According to the Principal of the Farm School, where 30 *uyones* had been harvested the previous year, about 50 *uyones* was the yield in 1925 from the far-apart-planting crop. All the increase in yield may not have been due to the far-apart-planting, yet the result obtained certainly warrants further trial. Besides, according to some Farm School pupils interviewed, they found less trouble in weeding the fields with the far-apart-planting.

It would seem from this case that the College of Agriculture might extend the benefits of the results of its experiments to all parts of the Islands through the farm schools of the Bureau of Education, especially if these farm schools were staffed, at least in part, by alumni of the College. And it would do a whole lot of good to the country if the College of Agriculture and the farm schools could co-operate in the extension of modern methods of farming and of the findings of the College which have been proved to be beneficial. The pupils in the farm schools are powerful potential agencies in agricultural improvement.

Care of fields

When the field has been planted, the farmer occasionally visits it, but gives practically no further care till harvest time. He may do some replanting, but this is infrequently done. Occasionally, many of the dikes are destroyed by overflow of the water, hence a reasonable amount can not

be kept in the paddy. It is not uncommon even during the rainy months for the water to be at a depth of less than from two to four centimeters. This depth is most favorable to the growth of weeds.

Harvesting and storing

Harvesting the rice crop in Ilocos Norte is a very slow process. It is done by hand with the aid of a native implement called *rakem*. Unless the type of rice grown there were changed, the introduction of a more rapid method of harvesting would find little favor. For when the crop is harvested the leaves must be separated from the panicles as the Ilocano rice is hard to thresh out. This separation could not be accomplished by machinery or by the sickle used in the Tagalog regions. So in Ilocos Norte the panicles are cut with the *rakem* one by one with about 30 centimeters of the straw going with them. The stripped panicles are tied into small bundles about five to six centimeters in diameter called *ñgabtek*. These bundles are carried to one place for stacking where they are arranged by sixes to form a *taratar*. This is done to facilitate the process of bundling the *ñgabteks* into *puñgo* when they are dry, as six *ñgabteks* are tied together to make one *puñgo*. The *pinuñgo* is exposed to the sun for about a week for further drying before it is stacked. The stack remains in the field till about the end of April, the beginning of the rainy season. The grain is stored, unthreshed, in barns. The palay keeps well under this condition. The writer saw palay in perfect condition that had been stored for about eight years. The rice when cooked, however, became brown and very hard. The bundles that are to be used for seed purposes are generally put on top of the pile in the barn. The palay for seed is not selected in the field but at the time the crop is stored in the barn, when usually the heavy bundles are put aside as sources of seed supply. Before these bundles are threshed, however, mixtures are eliminated by roguing.

The production per unit area is not measured by volume nor by weight, but by the *puñgo*, *baar*, and *uyon*. One *puñgo*, as stated elsewhere, is composed of six *ñgabteks* and generally gives from 2.5 to 3.5 gantas (7.5 to 10.5 liters) of clean rice, depending upon the quality and development of the rice panicles. Two *puñgos* make one *baar* and 10 *baars* make one *uyon*. The *uyon* is the unit generally used in expressing the production per hectare. This unit, however, is misleading for it does not give the actual amount of palay as do the cavan and the kilogram. Also the bundle frequently varies in size, and the panicles may have many empty grains which also vary in size and in development. It is, therefore, impossible to compare with any accuracy the production from the same piece of land from year to year, or that of different places.

In Batac, the writer made a few actual determinations on yield in four different places. The fields are considered to be under first and second

class rice fields in the municipality. The results, although inadequate, are presented in table 1 for the purpose of giving some idea as to the production of rice in Ilocos Norte.

TABLE 1

Production of rice in Batac, Ilocos Norte, 1925

BARRIO	AREA OF FIELD	ACTUAL YIELD		COMPUTED YIELD PER HECTARE	
	sq. m.	*baar*[a]	*gantas*	*uyon*[b]	*cavans*
Sarnap	490	6.5	(39.0)	13.3	(31.92)
Batac	1088	15.0	(90.0)	13.8	(33.12)
Bil-loca	882	9.5	(57.0)	10.8	(25.92)
Nagcurcuran	540	6.0	(36.0)	11.1	(26.64)
Average				12.23	(29.40)

[a] 1 *baar* gives about 6 gantas of clean rice.

[b] 1 *uyon* is equal to 10 baars.

With the average of the four determinations, one hectare of first and second class rice fields in Batac gives about 29 cavans of clean rice. In Bacarra, according to information gathered, the production per hectare ranges from 8 to 15 *uyones*. The *puñgo* in this municipality, however, as in other towns of the central part of Ilocos Norte is smaller. A *puñgo* on an average gives about 2.5 gantas of clean rice, so that one hectare would give on an average from 16 to 30 cavans of clean rice.

Cropping System

After the rice crop, some plants as mungo, corn, tobacco, cowpea, garlic, or onions are often planted, their importance in rotation with rice is in the order named. In the southern part of Ilocos Norte, however, many of the rice fields remain idle because of the lack of irrigation water. In this event, the fields are used for pasturing animals.

While there are no actual determinations on the effect of these different crops on rice, it is claimed that mungo and cowpea have a good after effect. It is said that tobacco and corn are *napudot* (hot), especially tobacco, while legumes are *nalami-is* (fresh).

OBSERVATIONS ON MUNGO AND COWPEA

Among the crops rotated with rice, mungo (*Phaseolus mungo*) and cowpea (*Vigna sinensis*) were given special attention in this study. While practically all the municipalities in Ilocos Norte grow mungo, there are only five in which it is grown rather extensively; namely, Bacarra, Dingras, Batac, Badoc, and Laoag. Cowpea is not given much attention. Bacarra and Batac were the only municipalities visited, the most time being spent in Batac where actual determinations of yields of mungo and cowpea were made by the writer.

In the municipalities visited, there were two distinct varieties of mungo grown, the green mungo and the yellow mungo, each receiving its name because of the color of the seed. The green variety has larger seed than the yellow. Out in the field it is hard to distinguish one variety from the other without resorting to the seeds. Both of these varieties are productive but the green one is given the preference. In Batac, it is the one almost exclusively grown, but in Bacarra the yellow variety is oftentimes mixed with the green. The farmers claim that the green variety is more appetizing and appealing than the yellow; perhaps its larger seeds may add to its popularity. Seed of the green variety was introduced in the College.

The writer came across five distinct varieties of the cowpea. It is claimed that four of them are native of the locality, one called *Otong Americano*, apparently is the New Era variety. The *Otong Americano* is not much liked by the farmers because it does not possess the good flavor of the native varieties. But it was very evident that it surpasses the native varieties both in productiveness and in adaptability to the climatic conditions of the locality. A certain farmer who is engaged in the culture of cowpea and mungo claims that the *Otong Americano* thrives very well and produces heavily when cold nights occur, a condition under which the native varieties generally fail. Of the more productive native varieties of cowpea, two were introduced in the College, a white seeded variety and a red seeded one.

The mungo and the cowpea require the same cultural treatment. Both are grown after the rice crop has been harvested. The cowpea, however, is sometimes interplanted with corn in upland fields (not devoted to lowland rice) as a supply of green vegetable. Its use as a green manure crop is hardly recognized among the farmers, although it is generally admitted that it is a good crop to rotate with other crops.

While some rice fields are cleared from the rice crop as early as November and December, planting mungo and cowpea does not commence till about the middle of January, because of the extremely cold nights in December and January. The plants would be stunted if planted early. That is why irrigation water is necessary in the culture of mungo and cowpea, as by the time the weather becomes favorable for the crop, most of the rice fields are dry. The water is needed to put the soil in proper tilth for soil preparation. In Batac there is hardship in the preparation of the land because of the limited amount of irrigation water, and because the soil is generally heavy. The field is cleared off; the rice straw is cut for hay or it may be burned. The field is plowed once and then harrowed two or three times so as to break the clods. The seed which has been soaked in water over night is planted in hills about 25 to 30 centimeters apart in the furrow. The furrows are about 50 centimeters apart. The planting is a slow process because of the poor preparation of the soil. To ensure moisture for germination the seed must be planted by the *bacal* method. Three to five seeds

are planted in a hill. After planting, no further care is given to mungo plants till harvest time; no cultivation or weeding, nor irrigation. In the case of cowpea the plants are topped when they are about three weeks old, the object of which is to induce them to produce more branches and fruiting stems. The tender tops are used as green vegetable.

In Bacarra, the method of mungo culture is different from that of Batac and other municipalities of southern Ilocos Norte. The field is first cleared off by burning the rice straw. The entire field is flooded and when the condition of the soil permits plowing, furrows of about 50 centimeters apart are made. The mungo or cowpea seed which is soaked over night is drilled by hand in the furrow, after which the field is harrowed once to cover the seed. Sometimes furrows are not made but the planter makes the holes for the seed with a sharpened pole. These holes are about 25 to 30 centimeters apart each way. This method is very much slower than with furrows but it is resorted to when work animals are not available. These two methods of planting give good results in Bacarra and in other places because the soil is alluvial in nature and does not crack very badly upon drying, as does the clay soil in Batac. However, where the field had been plowed before planting, such cases were noted here and there, the crop was very much better. In Bacarra, as in Batac, once the seed is planted no further care is given till harvest time. Mungo and cowpea plants are never irrigated, for if this were done, it would be at the expense of the grain. The plant grows luxuriantly, covering the ground well but producing few pods. The moisture of the soil at planting time is enough to mature the crop. The crop seldom fails because of drought, but cold nights, heavy winds and insect pests, as aphids, sometimes cause failure. Throughout the province there is a tendency to plant thickly.

The crop matures in two to two and one-half months. When the crop is good the plants are 60 centimeters or more high and are almost covered with pods. A mungo field that is ready to be harvested looks black in the distance. The pods are harvested by hand picking. This is a slow process and much labor could be saved by using sickles to cut the fruit bearing branches. The method of harvesting cowpea and mungo is the same throughout the province. The harvested pods are dried in the sun and then threshed by beating them with a flail.

As stated elsewhere, the actual determination of mungo yields was attempted in Batac. The limited data obtained are presented in table 2. The average production of mungo to the hectare is 12.6 cavans. No determinations were made in Bacarra as the pods were just in the dough stage when the writer visited this place. Production in Bacarra, according to information received, ranges from 8 to 12 cavans to the hectare, and the current price at that time (April, 1926) was from 8 to 9 pesos a cavan. In Batac the current price was from 9 to 10 pesos a cavan during the harvesting season.

TABLE 2

Production of green mungo in Batac, 1926

BARRIO	AREA OF FIELD	ACTUAL YIELD	COMPUTED YIELD TO THE HECTARE
	sq. m.	*gantas*	*cavans*
Sarnap	320	10.0	12.5
Sarnap	490	12.0	9.8
Suyo	210	6.5	12.4
Sumarcad	518	18.0	14.2
Aracua	280	10.5	15.0
Bil-loca	784	26.0	11.8
Average			12.6

Uses of mungo and cowpea

The mungo and the cowpea are used mainly as food. The mungo is one of the staple vegetable crops in Ilocos Norte, especially among the farmers. It is the most common vegetable used during the major operations on the farm, that is in the planting and harvesting seasons. Most of the mungo produced in the province is consumed locally, although some is exported to neighboring provinces. The mungo is used as a dry bean and is cooked in a number of ways.

The cowpea is not so popular as the mungo. It is more commonly used as a green vegetable than as a dry bean. It is claimed to produce more dry beans than the mungo. One determination made by the writer gave 20 cavans of clean beans to the hectare.

The straw after harvest is a valuable feed for live stock. It may be cut and used as green fodder or it may be left in the field and animals allowed to graze there. When the field is irrigated or there is rain after harvest, luxuriant growth follows, especially with cowpea. With the field legumes harvested, the question of feeds which is a rather acute problem in Ilocos Norte during the summer months is partly solved.

Besides the mungo and the cowpea, there is another legume in Ilocos Norte which has great possibilities as a grain crop as well as forage and green manure crops. It is a matter of regret that this crop is not given more attention. This legume (*Phaseolus calcaratus*) is called in the vernacular *otongbalatong*, because in appearance of leaves and flowers, it resembles the *balatong* (*Phaseolus mungo*) and the *otong* (*Vigna sinensis*) as to habit of growth. This legume stands drought better than mungo because of its tap root which penetrates deep into the subsoil. It is this quality of the plant that makes it very adaptable to the Ilocos region where prolonged droughts

oftentimes occur. In the summer of 1922, there was a long drought in the region and the *otongbalatong* grew luxuriantly and produced abundance of fruits, while the mungo was much affected by the drought.

The *otongbalatong* from Ilocos Norte was introduced into this College in 1922 and according to trials conducted here, its possibilities as a grain crop as well as a green manure crop are great. The grain of the *otongbalatong* is used as food in the same way as the mungo. While the taste is good it is not much liked, perhaps because it does not look appetizing as the seed becomes black when cooked. This undesirable color, however, could be eliminated by thorough washing after a preliminary boiling.

IMPORTANT FIELD DISEASES OF TOBACCO IN THE EXPERIMENT STATION AT LOS BAÑOS, AND IN NORTHERN LUZON, PHILIPPINE ISLANDS[1]

PEDRO A. DAVID AND EMILIANO F. ROLDAN[2]
Of the College of Agriculture

WITH EIGHT TEXT FIGURES

INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) is one of the leading export crops of the Philippine Islands and one of the chief sources of revenue for the Insular Government. For the period from 1920 to 1924 the Bureau of Internal Revenue reported a collection of ₱30,900,576.50[3] specific taxes and ₱2,211,-257.51 privilege taxes, or an average of ₱6,622,366.80 a year for manufactured tobacco products. Large quantities of tobacco are exported annually to Spain, United States, and other countries. On account of the importance of tobacco in Philippine agriculture and commerce the writers believe that the government should give due attention to the study of the diseases which cause an annual loss of thousands of pesos in this crop.

Diseases and pests are limiting factors in the production of tobacco, both in quantity and quality. As little effort is made to check their ravages, losses become more and more alarming every year. This is especially true in the Cagayan Valley in northern Luzon. The losses do not seem to attract much attention because no accurate estimates of their amount have ever been made. Some idea of how serious these losses are may be gained when one considers that the total average annual value of the 1920–1924 tobacco crops in Isabela and Cagayan provinces, is calculated to be ₱6,750,056.00, and tobacco growers claim that there is not less than 15 per cent of loss due to diseases. A considerable amount of the loss, which varies widely from year to year, caused by diseases could be reduced if tobacco growers were acquainted with the causes of the maladies and the factors affecting their outbreak and severity. The tobacco farmers in the Cagayan Valley who constitute the mainstay of the Philippine tobacco industry could not do anything better in the way of regaining the former reputation of Philippine tobacco, or at least to maintain the present status, than to begin to study the best possible means of protecting their plants from fungous diseases.

The present work is an attempt to describe the symptoms of the common and destructive tobacco diseases, their nature and causes, the conditions favoring their development and suggestions for control measures.

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[2] The writers wish to thank Dr. G. O. Ocfemia of the Department of Plant Pathology for suggestions and criticisms in the preparation of the manuscript.

[3] ₱1.00 (100 centavos) = $0.50 U. S. currency.

That the paper may be of practical value, only the most common and important tobacco diseases occurring in the provinces of Cagayan and Isabela in northern Luzon and in the College of Agriculture Experiment Station at Los Baños are described. No cases of the *Fusarium* wilt and *Thielavia* root-rot reported by Clara (1925) in the Philippines and by Johnson (1924) in the United States have been noted at Los Baños.

Nature and causes of tobacco diseases

Non-parasitic, or physiological troubles. There are diseases of tobacco known as non-parasitic, or functional diseases which are due to effects of unfavorable environmental conditions. Non-parasitic diseases may be due to effects of weather conditions, lack of proper supply of salts in the soil, soil water, soil aëration, excessive heat, lightning injury, poisonous gases, etc. Each of these, causes some disturbances and interferes with the normal development of tobacco. Some of the diseases resulting from unfavorable environmental conditions may be remedied. The lack of proper soil constituents may be corrected by the application of fertilizers, the improper water supply may be corrected by proper attention to drainage and irrigation, soil aëration may be improved by thorough cultivation of the field, etc. Many physiological diseases are worse on certain varieties than on others. A knowledge of the predisposition of the variety to the disease is of the utmost importance in the control of some of these physiological troubles. There are also physiological diseases the causes of which are entirely unknown.

Parasitic diseases. Fungi, bacteria, and eelworms, or nematodes cause diseases of tobacco. There are tobacco diseases which are classified as parasitic maladies, the causes of which are not yet definitely known. The writers are referring to the chlorotic diseases, as the mosaic, mottled leaf, etc., which are highly infectious. Investigators on chlorosis and related diseases have shown that they can be readily reproduced by infecting healthy plants with juice from infected ones. Owing to the highly infectious nature of the juice of infected plants these diseases are said to be caused by viruses. Chlorosis and related diseases are some of the most destructive maladies not only to tobacco but to other important crops.

Conditions affecting the severity of tobacco diseases

The severity of infection and the destructiveness of tobacco diseases differ under different conditions. This is because certain surrounding conditions have direct influence on the virulence of the parasites and susceptibility of the plants. Under favorable conditions the parasites attain their optimum development, resulting in the production of the disease in severe form. Climatic conditions, soil condition, and cultural methods are among the chief factors which are responsible for the predisposition of plants to the attack of the disease. With the exception of weather, which is beyond human control, these factors may be corrected to favor the growth of the plants. Unfavorable weather conditions, however, can be avoided by changing the time of planting. Professors Elayda and Lopez of this College and the senior author visited the tobacco regions in the Cagayan Valley in April, 1926. In Isabela Province we were told that

the tobacco is transplanted fairly early and that the losses from diseases and pests were much smaller than in Cagayan Province, where the transplanting is done unusually late. Warm and moist atmosphere favor the development of many plant parasites. Weedy fields favor outbreaks of diseases, because many organisms, including the viruses of chloratic diseases, remain on wild hosts between tobacco seasons. It is not uncommon to see tobacco fields in the Cagayan Valley seriously infected with mosaic. The tobacco farmers are not aware of the causes and control of this pernicious disease.

An abundance of decaying organic matter is favorable for soil-borne diseases. Damp soil, crowded planting, and poor cultural methods are conditions which are conducive to epiphytotic outbreaks of diseases. Unhealthy plants are more readily attacked than those which are healthy.

Fig. 1.—Portion of a seed bed of tobacco showing infection of the seedlings by damping-off due to *Pythium debaryanum* Hesse. Note the dead and rotted seedlings in the center extending well towards the upper right hand corner. Slightly reduced.

DAMPING-OFF, OR SEED BED ROT

Symptoms. Damping-off, or seed bed rot is a very common disease of tobacco seedlings in seed flats and nursery beds. The disease is indicated by water-soaked, necrotic and sunken lesions on the stems of affected seedlings. In seed beds, damping-off is characterized by dead and rotting seedlings in patches appearing as though they had been scalded with hot water (fig. 1)[4].

[4] Figures 1, 3, 4, 5, and 7 are from photographs by the Photographic Laboratory, Department of Agronomy, College of Agriculture, Los Baños, P. I. Figures 2, 6, and 8 are from photographs by the Bureau of Science, Manila, P. I.

Infection may occur on seedlings as soon as they emerge or at any stage of the development of the seedlings. Infection at the beginning is sporadic, but subsequently other infections occur. Under favorable conditions, damping-off may wipe out within a comparatively short time the seedlings of entire plots or beds. Individual infected seedlings are attacked at the stem just above the surface of the soil. Owing to the peculiar location of the points of infection, affected seedlings are unable to recover. The disease occurs in patches of varying sizes (fig. 1) in the flat or bed.

Cause. According to Clara (1925) damping–off of tobacco is due to *Pythium debaryanum* Hesse, *Phytophthora nicotianæ* Breda de Haan, *Sclerotium rolfsii* Sacc. and *Rhizoctonia solani* Kühn. In the present investigation the writers found that the damping-off, or seed bed rot of tobacco is caused chiefly by either *Pythium debaryanum* or *Rhizoctonia solani* or both. *Sclerotium rolfsii* very seldom occurs on tobacco seed beds and, if it does, the characteristic white growth cannot escape detection. *Pythium debaryanum* is most commonly responsible for the disease and *Rhizoctonia solani* is usually associated with it. *Rhizoctonia solani* is rarely found occurring independently of *Pythium debaryanum* in cases of tobacco damping-off. *Pythium debaryanum* and *Rhizoctonia solani* being soil-inhabiting organisms are capable of existing in the soil as saprophytes, and become active parasites when favorable conditions occur. *Pythium debaryanum, Rhizoctonia solani* and *Sclerotium rolfsii* attack a great variety of plants grown in seed flats, in seed beds, and in nurseries (Ramos, 1926). They pass through adverse conditions by producing certain specialized fungous bodies which are capable of remaining in the soil under unfavorable conditions without their vitality being affected.

Conditions favoring the disease. Soil in which there is rotting infected plant material is a source of frequent outbreak of damping-off. Favorable temperature and humidity are other factors aiding development of the disease in a severe form. Experiments at Los Baños have shown that *Pythium debaryanum* is favored by a warm and humid atmosphere, while *Rhizoctonia solani* prefers moist air at a lower temperature. These are the reasons why damping-off diseases are common in seed beds and nurseries where these conditions are frequently present.

Control. The control of damping-off may be preventive, cultural, or checking methods. Under preventive methods, there is the soil sterilization by roasting or direct surface firing of the soil or by spraying it with formalin solution. Control by the cultural method is simple, as it means not sowing an unnecessarily large quantity of seed in seed beds. Crowded seedlings are more subject to damping-off because the air between the plants cannot circulate freely and crowded planting facilitates the rapid growth of the fungus from one plant to another. The injury to the seedlings is in direct proportion to the thickness of sowing the seed on seed beds. Fifteen grams of tobacco seed with a germinating capacity of 80 to 90 per

cent will sow 12 to 15 meters of a bed one meter in width. The checking method means the prevention of damping-off by "sunning" or exposing the plants to the sun for a while during the day. Sunning may be done by removing the covers from the beds or by exposing seed flats to the sun so as to allow the excessive moisture from the soil and air between the plants to evaporate.

Prevention is the most important method of damping-off control. Selection of a proper site which is free from damping-off should be carefully considered. Soils or manures which contain dead or rotting infected plant material should never be used in seed beds for these are sources of infection. Soils from doubtful origin when used in seed flats for germinating tobacco seeds should be thoroughly sterilized or disinfected. Experiments have shown that infections frequently occur sporadically in soils despite the fact that they have been sterilized or disinfected. This type of infections is difficult to avoid. The further spread of infection, however, can be prevented by pulling out all infected seedlings including some of the soil around them as soon as damping-off is noted. The infected patches may be disinfected by the application of a 1:50 formaldehyde solution at the rate of 10 liters to a square meter of bed. A one per cent copper sulfate solution when applied at the rate of 3.5 liters to a square meter of bed before the seeds are sown has proved effective in controlling damping-off of tobacco seedlings. The objections to the use of chemicals are that the Philippine tobacco growers have neither training nor experience in many such materials and, if they had the knowledge, the cost together with the trouble of securing the chemicals make their use by the small tobacco growers prohibitive. One petroleum can of boiling water poured on one square meter of well pulverized bed will check damping-off to a great extent. Avoid thick planting, excessive watering, and a heavy shade, for these create conditions favorable for the development of damping-off. Seedlings showing lesions of damping-off should not be pricked because they form sources of infection for other seedlings.

MOSAIC

Description. Mosaic disease occupies a prominent position among the many diseases of tobacco. It is very prevalent in Los Baños, Laguna, and in the towns of Amulung, Alcala, Peñablanca, Tuguegarao, Piat, and Tuao in Cagayan Province and in the towns of Cabagan, Tumauini, Ilagan, Naguilian and Echagüe in Isabela Province. Mosaic does not only cause serious damage to tobacco but it also occurs on a wide range of hosts producing more or less the same general type of symptoms and effects. On tobacco, the disease occurs at any stage of the development of the plant. In seed beds, while the plants are young, the symptoms appear on the new leaves which are unfolding. The young leaves gradually curl and become mottled. While the plants are growing, infected leaves become variously

mottled with localized dark green patches surrounded by yellowish or light green areas. The green portions grow faster than the light colored areas, resulting in the malformation of the leaves and in their irregular mottled appearance. This makes the appearance of the leaves very striking (fig. 2). On mature plants in the field, infection starts on young leaves at the top causing the formation of a mottled top. In most cases the plants become stunted. On the leaves the lesions are characterized by the formation of dark green colored patches with yellowed areas around them (fig. 2). The yellow parts present a typical chloratic condition. At times, infection may extend to the flower producing on them irregular minute galls which afterwards

Fig. 2.—Two leaves of tobacco of varying ages photographed to show the mottling characteristic of tobacco mosaic.

become brown blotches (fig. 3). In severe cases of infection the flowers are rendered sterile.

Cause. Different hypotheses regarding the cause of tobacco and other mosaics have been advanced. Some maintain that the disease is due to enzymes, others believe that it is due to abnormal environmental conditions, while still others believe that it is due to certain parasitic organisms. The consensus of opinion is that mosaic and related diseases are due to ultramicroscopic organisms. It has been proved that the disease is highly infectious, being readily transmitted from diseased to healthy plants. Since

the disease probably occurs on a number of hosts, tobacco mosaic can be transmitted to other plants and *vice versa*. No effort has been made during the course of this investigation to determine whether one or more mosaics attack Philippine tobacco. Fernow (1925) and Johnson (1926) report that more than one mosaic attacks tobacco in the United States. Experimental evidence indicates that the causative agent does not remain in the soil but lives over on susceptible weeds or on the living underground parts of tobacco or some perennial plants. For this reason, if the continuous occurrence of the mosaic disease of tobacco is to be avoided, volunteer tobacco plants and roots of tobacco and weeds should not be tolerated in the field.

Fig. 3.—A mature tobacco plant with almost mature capsules showing the deformations and distortions of the foliage due to infection by the mosaic disease. The plant was infected when it was well advanced in its development.

Conditions favoring occurrence and spread. The occurrence of mosaic disease is dependent upon the sources of infection. Where there are mosaiced plants growing near by, mosaic is bound to occur. A temperature of 27° to 30° C. has favorable effects on the development of the disease. This range of temperature exists in the Philippines during the entire tobacco season. Temperatures higher than the above retard the development of mosaic. Very rapidly growing plants are subject to mosaic infection. Insects are the chief carriers and bear a direct relation to the occurrence of mosaic.

Control. In controlling mosaic disease the aim should be directed chiefly to eradication and protection since the disease can not be cured by any therapeutic means. As infection usually originates in seed beds, they should be guarded from any contamination, so as to protect the tobacco from mosaic. The seed beds should be isolated so that it is far from weed hosts of mosaic. Once the seed bed is infected, the plants should be destroyed and the soil changed. Injuries on the seedlings when they are handled should be avoided because these serve as avenues of infection for the mosaic virus. Roots of infected tobacco should not, under any circumstances, be

left in the seed bed or in the field. The field should be perfectly free from any mosaiced plants or weeds. Laborers readily communicate infection from diseased to healthy plants in worming, suckering, and topping tobacco plants in the field. Insects are carriers of infection in the field. However infection takes place, the prompt removal of the mosaiced plants is a very important means of preventing the spread of the disease.

ROOT-KNOT

Symptoms. As the name of the disease shows, root knot is confined to the root system of the tobacco. Galls of various forms and sizes at various points on the main and subsequent branches of the roots and on

Fig. 4.—A root system of tobacco showing root galls due to *Heterodera radicicola* Greef and Müller.

rootlets are formed (Godfrey, 1923) (fig. 4). With this abnormality, the absorbing power of the roots is seriously hampered. A serious hindrance to the proper supply of water to the leaves results in wilting of the foliage. The wilting differs from other types of wilt disease in that plants suffering from root knot are pale green, and the wilting is general, uniform and persistent. The plants may be infected at any time from the transplanting from the seed bed to the field up to maturity. The severity of

attack varies. Mild cases of infection do not affect the stand very much, and the damage is almost negligible, but in severe forms of infection the plants are seriously stunted, or dwarfed, and the leaves may turn yellow and eventually die (Godfrey, 1923).

In northern Luzon the disease is very common in Naguilian and Echagüe in Isabela Province and in the towns of Alcala, Amulung, Solana, Tuao and Tuguegarao in Cagayan Province.

Cause. Roots of plants infected with galls when crushed on a slide and mounted under the microscope show that they are filled with eelworms, or nematodes. These worms are very small and are invisible to the naked eye. Of the species of nematodes attacking Philippine plants *Heterodera radicicola* Greef and Müller is responsible for the root knot disease, not only of tobacco but of other agricultural plants. The parasite is a soil-inhabiting organism living upon decayed organic matter for a considerable length of time, the shortest of which is about three years. The organism gains entrance to the plant by boring its way into the young roots usually at the tips (Godfrey, 1923). As soon as they are inside the roots the nematodes invade the tissues, and irritate them, thus producing abnormalities on the roots in the form of galls, enlargement, distortion, and various kinds of deformations.

Conditions favoring the disease. The root-knot organism is common in tropical countries. Warm climate favors the development of the disease. The activities of the life generation of the organism is governed by warm temperature. Soil is another condition associated with the controlling factors in the development of the organism. Light, sandy, and friable soil is best suited to the development of nematodes, they seldom if ever develop in heavy clay. Since the parasite has a great variety of hosts, it is essential that tobacco plants should not be grown in the fields in which there have been plants that are subject to the attack of the disease as the parasite may have been established in the soil. Godfrey (1923) lists a number of plants immune or only slightly susceptible to root-knot, of which corn, peanut, sorghum, velvet bean, and soybean occur in the Philippines and can be used in the crop series with tobacco. Dead rotting material of infected plants when allowed to remain in the field serve as breeding places for this parasite.

Control. The control of the root-knot disease consists chiefly in the eradication of the parasite. This can be effectively accomplished by thorough sterilization of soil in seed beds. Very few, if any, of the farmers in the Cagayan Valley sterilize their seed beds to prevent the development of root-knot on the seedlings, although this disease is one of the serious maladies with which the farmers in the Cagayan Valley have to deal. Systematic and continuous crop rotation should be followed so as to starve the organism, or varieties resistant to the attack of nematodes should be used. Plant material which has been infected should not be allowed to remain in the field for it serves as a source of infection. Cowpeas, although

reported by Godfrey (1923) as resistant, and tomatoes were found subject to injury by the tobacco nematodes, hence they should not be used in a crop series with tobacco. It was found in fertilizer experiments in the Experiment Station of the College of Agriculture that a liberal supply of potash

Fig. 5.—A tobacco plant infected with the bacterial wilt due to *Bacterium solanacearum* EFS. (*Phytomonas solanacearum* (EFS.) Com. S. A. B.). Note the characteristic wilting of all the foliage.

Fig. 6.—Two tobacco plants showing wilting and death of the leaves due to the destruction of their roots and the obstruction of the vessels at the foot of the plants caused by *Sclerotium rolfsii* Sacc. This is one of the most common soil-inhabiting parasites in the Philippines. The fungus causing this disease attacks many plants, some of which are of great economic importance.

fertilizer minimizes the attack of nematodes, but does not entirely eliminate them. It is suggested that extensive experiments at the Ilagan Tobacco Experiment Station be carried out to find the most satisfactory method of controlling root-knot under the conditions in the Cagayan Valley.

BACTERIAL WILT

Symptoms. The bacterial wilt of tobacco is another serious disease of tobacco in the Philippines. In the United States the disease is known as Granville wilt as it was first discovered in Granville County, North Carolina. The first indication of the disease is the wilting of one or two of the youngest leaves. The wilting advances gradually until all the leaves are wilted (fig. 5). Newly wilted leaves are not discolored but they become pale green, then brown with age. The plants may be attacked at any stage of development in the field. Young plants when seriously infected become stunted and often die prematurely. In mild cases of infection and when the conditions are not favorable for the disease the leaves on only one side of the plants are wilted. Occasionally the plant recovers, although normal development is hampered. Severe outbreaks of bacterial wilt in the field is characterized by the persistent wilting and death of the plants, reducing the stand considerably. When stems of plants affected by the bacterial wilt are cut across, a slimy mass of dirty white color oozes out from the xylem. Affected plants when pulled up show rotting of the roots. If the bark of the woody portion of the stem is peeled off, a yellowish to dark brown color may be noted.

Cause. Tobacco wilt is caused by *Bacterium solanacearum* EFS. (*Phytomonas solanaceara* (EFS.) Com. S.A.B.). This organism produces wilt disease on various other members of the family Solanaceæ, such as tomato, pepper, *Petunia*, eggplant, etc., as well as of other plants of other families notably castor bean, tañgo, *Cosmos*, and cockscomb. The bacterium is a short rod with rounded ends. Experiments have demonstrated that the parasite enters the roots through injuries made either by nematodes, insects, or careless handling of the seedlings. After gaining entrance to the host, the bacteria advance and locate themselves in the xylem tubes, where they multiply very rapidly, clog the tubes and stop the ascent of water from the roots to the leaves. The organism is capable of remaining in the soil for a long time, causing frequent infection when the field is planted to susceptible hosts. The severity of the wilt varies according to weather conditions. Investigations proved that once the soil is badly infected, it is almost impossible to get rid of the wilt. Experiments in the College of Agriculture show that the application of commercial fertilizers to the soil has no influence upon the occurrence of the wilt on tobacco.

Conditions favoring the disease. Bacterial wilt of tobacco is very common during the dry season of the year. This observation shows that warm climate favors the disease. As demonstration has shown that various plants other than Solanaceæ are subject to the attack of the disease it is likely that infection will occur as long as susceptible hosts are present. Soils on which the disease has occurred previously remain infected with the organism for a long period. If such soils are used for susceptible crops the wilt disease occurs. It is very probable that the organism lives over in

the soil and on dead material of infected plants, remains under such conditions, and later becomes parasitic.

Control. As the organism responsible for the disease can exist in soil for a long time, it is obvious that in controlling the disease, attempts should be directed toward the destruction of the parasite. No remedy has been found entirely satisfactory to the tobacco farmers, but systematic crop rotation in which tobacco and other susceptible hosts, such as those mentioned above, are withheld from the crop series so as to starve the parasite. This is considered one of the most effective methods of control. Planting

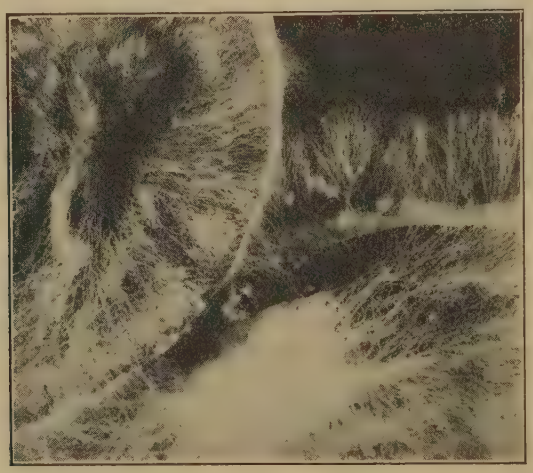

Fig. 7.—A slightly enlarged photograph of the growth of *Sclerotium rolfsii* Sacc. causing the root rot of tobacco on organic matter on the soil. This type of growth is often seen in infected fields on mornings following rainy days. The growth on the soil and host plants cannot be mistaken on account of the white color of the fungous filaments and in the presence of the knot-like growths, the sclerotial bodies which are at first white but later on become brown.

resistant tobacco varieties is also of much importance. In soils in which the wilt has never been known to occur precaution should be taken not to plant any of the susceptible plants which have been obtained from other places. Never grow two crops of tobacco in succession on infected fields. Avoid, as far as possible, all possible chances of contamination from wilt disease. Growing tomatoes, peppers, eggplants, tañgo, castor oil bean, *Cosmos*, cockscomb, and various other plants on infested land should be avoided because these plants are susceptible to the wilt, and if planted opportunity is given to the bacteria for rapid multiplication.

BASE STEM ROT

Symptoms. Although the base stem rot of tobacco seldom occurs, it may occasionally become a serious disease, reducing the stand of the crop in the field considerably. The disease is characterized by the rotting of the bases of the plants, generally confined to the region at the base of the stem close to the soil surface (fig. 6). Sometimes the lesion may advance a few centimeters above the soil line. The infection causes all the tissues, except the woody portion to rot, while white cottony sterile mycelium (fig. 7) are copiously produced at the base of the plant. A little later, sclerotial bodies, which are at first white but later become brown, are found among the white fungous hyphæ. The plant is girdled, causing it to wilt, characterized by the pale yellow drooping leaves (fig. 6). The wilting becomes persistent and eventually the plant dies.

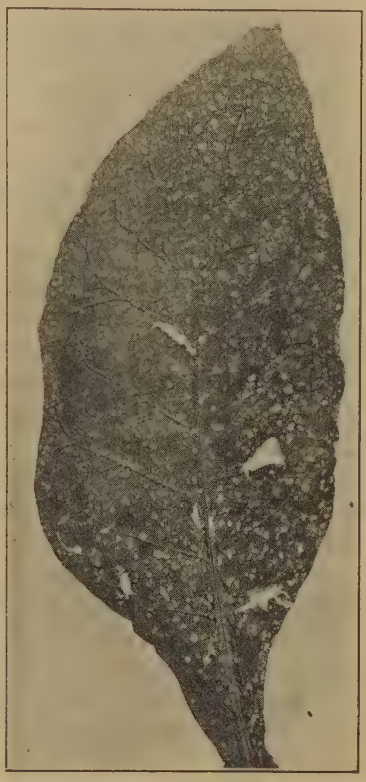

Fig. 8.—A mature leaf of tobacco showing the presence of an abundance of spots due to *Cercospora nicotianæ* Ell. and Evht. Note the size, shape, and distribution of the spots.

Cause of the disease. The disease is caused by one of the soil fungi, *Sclerotium rolfsii* Sacc. This fungus is found occasionally associated with the damping-off fungi, but usually it develops and produces disease independently of the others. The fungus is a common rot-producing fungus of various kinds of plants. When the host dies the fungus produces abundant sclerotial bodies, which are capable of remaining dormant in the soil for a long period of time. These bodies may be carried from one place to another by streams, on the feet of laborers and animals, on implements and by other agencies.

Conditions favoring the disease. The disease is especially favored by cool and wet weather. On damp soil the disease is likely to develop. The fungus is also capable of attacking a wide range of hosts including weeds. It is essential, then, to keep the field free from weeds so that the parasite may not live on them and infect tobacco plants later.

Control. Since wet and poorly drained soil favor the disease, it is important to avoid such conditions as much as practicable. Weedy fields should be kept cultivated. In severe forms of infection, systematic rotation is important.

CERCOSPORA LEAF SPOT, OR FROG EYE

Symptoms. This disease is confined to leaves of tobacco and is very common in every place where tobacco is grown in Los Baños and in the Cagayan Valley. The disease appears most abundantly on "sand" leaves. Under ordinary conditions the disease is of minor importance and causes little or no damage. It may attack the plant at any stage of development. The lower mature leaves are usually most seriously attacked. Under exceptionally favorable conditions the disease may occur in a severe form. The outstanding and characteristic symptoms of the disease are the presence of spots (fig. 8). The spots are circular, two to five millimeters in diameter, and seldom attain the maximum size of more than five millimeters in diameter. The spots are light brown to brown or reddish brown, having grayish color in the center. Spotting occurs very heavily on the bottom leaves. Young leaves are generally free from infection or if infection occurs on them it is very slight. In severe infection the spots may coalesce causing the greater portion of the leaves to become papery. The disease may be identified with certainty by using a magnifying hand lens with which the masses of minute fungous structures can be seen in the center of the spots.

Cause. The disease is caused by *Cercospora nicotianæ* Ell. and Evht. a leaf-spot-producing fungus, the fruiting bodies of which are located abundantly in the center of the spots. The conidiophores are short filamentous structures, brown, septate, and in bunches. The conidia are easily detached from the conidiophores, hyaline, septate, linear, straight or more or less curved, and obclavate. In the presence of moisture they germinate readily, producing germ tubes. As to whether or not the fungus can remain in the soil and exist in the absence of a host can not be stated with certainty, but the repeated appearance of the disease in the field each time tobacco is grown there, as tobacco growers say is the case, suggests the possibility of the fungus existing in the soil saprophytically. According to Clara (1925) the frog-eye disease of tobacco is known as *batec* in the Ilocano dialect. The writers believe that the batec is a physiological leaf spot, the presence of which on the tobacco is much desired by the northern Luzon tobacco growers. The relation between batec and frog-eye may be shown by the fact that batec leaves cost five centavos each in Ilocano and Cagayan markets while frog-eye infected leaves are not desired. Experiments on artificial production of batec have not given successful results. Batec is not transmitted to other plants. Tobacco leaves with the true batec on them are not used for wrapper purposes because they are too thick and strong for that purpose.

Conditions favoring the disease. Moisture is essential for the germination of spores. The infection which is rather severe on the bottom, or sand leaves, is attributed to the fact that morning dews usually collect on them. As a rule, mature leaves are more heavily infected than the immature,

probably because they are more susceptible to infection than the younger ones. This also suggests that the fungus probably remains in the soil between tobacco seasons. If infected fields are continuously planted to tobacco, the disease becomes persistent. As far as varietal susceptibility of tobacco is concerned, no variety, as yet, has been found which is resistant to leaf spot disease. All tobacco fields in the Cagayan Valley are invariably infected with this disease. Too much organic matter used as manure favors the development of the disease.

Control. On account of the fact that the leaf spot disease does not occur in serious form and if it does, only on very rare occasions, nothing has been done on the studies of the fungus in its relation to soil which can be used as a guide in formulating an effective method of control. In severe cases, however, frequent and constant picking off of the affected bottom, or "sand" leaves, practice of crop rotation, planting in proper season, and proper distancing of plants will minimize the damage to a certain extent. From the results obtained in fertilizer experiments in the College of Agriculture, too much ammonia is likely to increase injury from the disease, but a liberal application of potash may check the disease.

LITERATURE CITED

Clara, F. M. 1925. Diseases of tobacco (*Nicotiana tabacum* L.) in the Philippines. Dept. Agric. and Natural Resources, Bur. Agric. Cir. 171. *In* Philippine Agric. Rev. (Fourth Quarter) **18:** 564–570. *Pl. 89–96.*

David, Pedro A. 1919. The tobacco seed beds. The Philippine Agricultural Review (First Quarter) **12:** 31–65. *Pl. 7–16.*

Fernow, Karl Hermann. 1925. Interspecific transmission of mosaic diseases of plants. Cornell Agric. Exper. Sta. Memoir 96: 3–34. *Pl. 1–7.*

Godfrey, G. H. 1923. Root-knot: Its cause and control U. S. Dept. Agric. Farmers' Bull. 1345: 1–27. *Fig. 1–26.*

Johnson, James. 1926. Mosaic diseases on differential hosts. Phytopath. **16:** 141–149. *Pl. 10–14.*

Johnson, James. 1924. Tobacco diseases and their control. U. S. Dept. Agric. Bull. 1256: 1–56. *Pl. 1–17, fig. 1–24.*

Ramos, José C. 1926. Pythium damping-off of seedlings. The Philippine Agriculturist **15:** 85–97. *Pl. 1, fig. 1.*

STUDIES ON THE RATE OF GROWTH OF CANTONESE CHICKENS[1]

LUIS J. DAÑGILAN

WITH ONE CHART

Among the foreign breeds of fowls that have been imported into the Philippines, the Cantonese has been found to be one of the most promising and the best adapted to local environmental conditions. For this reason the Cantonese is the most widely spread foreign breed in the Islands. A study of the rate of growth and physical make-up of this popular imported breed should be of considerable aid in planning work leading towards its improvement.

It was with this object in view that the present work on the determination of the rate of growth of Cantonese chickens was undertaken. It was carried on in the Department of Animal Husbandry. The work lasted for eleven months, from February, 1922, to December, 1923.

MATERIALS AND METHODS

Stock

The stock used consisted of 107 chicks furnished by the department. These were all hatched naturally. As all were hatched in the same season, February to April, 1923, the climatic conditions of the hatching period were practically the same. The first hatch, which numbered 42 chicks, was brought down on February 11; the second hatch of 30 chicks on February 25; the third hatch of 35 chicks on April 1.

After the chicks were properly leg-banded and weighed they were placed in the rearing pens and were naturally brooded.

The chick pen has a concrete floor covered with fine sand and is enclosed with poultry wire netting. When the chicks were one month old they were transferred to the poultry yards where they could have all the range they wanted. Here the chicks were housed in brood coops especially made for the purpose. The hens rearing the chicks were confined in the brood coops while the chicks were allowed to range free. When two months old the chicks were weaned. They were kept in the same coop, however, until they were three months old, when they were put in one of the open-front combination-roof type poultry houses of the department. This house is provided with perches, droppings board, trap nests, and two bamboo troughs.

[1] Thesis presented for graduation, 1924, with the degree of Bachelor of Science in Agriculture from the College of Agriculture No. 233; Experiment Station contribution No. 392. Prepared in the Department of Animal Husbandry under the direction of Dr. F. M. Fronda.

Feeding and management

Feeds used. The chicks were given grain and mash feeds. The grain feeds consisted of corn and rice in the proportion of 6 parts by weight of corn and 4 parts by weight of rice. The grain was ground fine for the first few weeks and coarse the last few weeks of feeding. On account of the scarcity of rice in the department, the feeding of this grain was stopped when the chicks were two months old and corn alone was given.

The mash mixture consisted of 6 parts by weight of rice bran, 4 parts by weight of corn, and 4 parts by weight of finely ground snails. The chicks were given green feeds consisting of finely chopped green grass during the time they stayed in the chick pen; this was stopped when they were allowed free range in the poultry yards. The snails were refused by the chicks when they were six weeks old, so this feed was changed to ground dried shrimps. Milk was used to insure a normal growth of the chicks. It was given as drink and for moistening the mash during the first two months. After that it was used only for moistening the mash and water was given as drink, instead. After the chicks were three months of age no milk at all was used. All the changes in the feed and in the amount of milk given were made gradually.

Feeding method. The chicks were given their first meal about forty-eight hours after hatching. They were fed five times a day for the first week and three times a day from the second week to the end of the experiment. During the first week the grain feed was given at about six o'clock in the morning, and at six o'clock in the afternoon. Wet mash was given about nine o'clock in the morning and three o'clock in the afternoon, and dry mash was given at noon. That they might not be overfed the chicks were given for the first week only what they could clean up in ten to fifteen minutes; from the second week to the end of the work, what they could clean up in about twenty minutes.

Dry mash was open to the chicks for one-half day every day from the second week to two months of age; and all the time from the third month to maturity.

Growth record

The growth of the chicks was determined by their increase in weight every week. The chicks were individually weighed about forty-eight hours after hatching and at seven-day intervals thereafter to the end of the experiment. They were weighed in a Henry Troemner arm balance, sensitive to 500 milligrams, during the first three weeks, after which period an ordinary direct reading spring balance, sensitive to twenty-five grams, was used.

RESULTS AND DISCUSSIONS

Rate of growth

Weights. When chicks are very young the sex can not be determined, so no distinction as to the sex of the chicks was made during the first eight weeks. They were wing-banded, however, so that it was possible to segre-

gate their weights after their sex was determined. They were grouped together as shown in table 1. This table shows the average weekly growth of the entire flock during the first eight weeks of their lives. Upon examination of this table it may be seen that on an average a Cantonese chick about forty-eight hours old weighs 28.6 grams. This weight is heavier than that reported by Lindayag (1918), which was 26.5 grams about twenty-four hours after hatching.

TABLE 1

Average weekly weight of combined male and female Cantonese chicks [a]

AGE	NUMBER OF CHICKS	AVERAGE WEEKLY WEIGHT	AVERAGE WEEKLY GAIN
		grams	*grams*
1 day	107	28.6	——
1 week	107	36.6	8.0
2 weeks	104	46.2	9.6
3 weeks	102	69.5	23.3
4 weeks	102	90.6	21.1
5 weeks	92	101.6	11.0
6 weeks	85	126.5	24.9
7 weeks	75	143.5	17.0
8 weeks	72	175.5	32.0

[a] The weights were separately recorded when the sex could be determined.

Growth of feathers. The only means by which sex can be determined externally in young chickens is by their combs, wattles, and feathers. These do not appear distinctly in females until they are about one and a half months old; in males, at about two to two and one-half months of age. The order of growth of the feathers in both sexes, however, is the same.

In both sexes the first feathers that appear are the primary wing feathers; second, the secondary wing feathers; third, the feathers of the saddle, back, and sides of the body; fourth, the feathers of the breast; fifth, the feathers of the thighs; sixth, the feathers of the neck; seventh, the feathers of the tail; and lastly the fluffs.

Sex. The cockerels at eight weeks of age can be clearly distinguished by their larger combs and wattles. The surest method is by examining the feathers on the back and saddle. The cockerel's feathers at these particular places are rather long and pointed while those of the pullet are short and rounded at the end.

After the sex could be determined, the weekly growths of the male and female chicks that lived through the period of observation were separately recorded (see table 2). Thirty-five chicks died before they were eight weeks old; these were not included in this table as the sex was not determined. According to the figures given in table 2, the male chicks

TABLE 2

Average weekly weights of male and female Cantonese fowls

AGE IN WEEKS	MALES			FEMALES		
	Number of birds	Average weekly weight	Average weekly gain	Number of birds	Average weekly weight	Average weekly gain
		grams	*grams*		*grams*	*grams*
1 day old	41	30.4		31	28.1	
1	41	42.3	11.9	31	34.1	6.0
2	41	62.8	20.5	31	42.9	8.8
3	41	90.5	27.7	31	50.7	7.8
4	41	120.4	29.9	31	62.5	11.8
5	41	140.2	19.8	31	72.1	9.6
6	41	160.2	20.0	31	96.3	24.2
7	41	180.1	19.9	31	113.3	17.0
8	41	200.6	20.5	31	139.3	16.0
9	41	244.2	43.6	31	161.8	22.5
10	41	278.1	33.9	31	195.9	34.1
11	41	321.9	43.8	31	228.6	32.7
12	41	355.1	33.2	31	262.7	34.1
13	41	435.6	80.5	31	313.5	50.8
14	41	486.5	50.9	31	366.2	52.7
15	41	533.6	47.1	31	417.0	50.8
16	41	612.2	78.6	31	458.1	41.1
17	41	671.9	59.7	31	515.1	57.0
18	41	749.1	77.2	31	568.1	53.0
19	41	819.0	69.9	31	632.1	64.0
20	41	890.0	71.0	30[a]	700.6	68.5
21	41	985.5	95.5	30	737.5	36.9
22	41	1072.4	86.9	30	812.5	75.0
23	41	1124.1	51.7	30	901.2	88.7
24	41	1223.0	98.9	29[b]	986.0	84.8
25	41	1282.5	59.5	29	1031.0	45.0
26	41	1350.7	68.2	28[c]	1091.3	60.3
27	41	1430.1	79.4	27[d]	1151.3	60.0
28	41	1480.6	50.5	25[e]	1204.8	53.5
29	41	1526.2	45.6	21[f]	1248.2	33.4
30	41	1569.3	43.1	18[g]	1300.0	51.8
31	41	1609.8	40.5	15[h]	1330.0	30.0
32	41	1648.8	39.0	11[i]	1338.4	8.4

[a] One pullet was removed from the flock after laying the first five eggs.
[b] One pullet was removed from the flock after laying the first five eggs.
[c] One pullet was removed from the flock after laying the first five eggs.
[d] One pullet was removed from the flock after laying the first five eggs.
[e] Two pullets were removed from the flock after laying the first five eggs.
[f] Four pullets were removed from the flock after laying the first five eggs.
[g] Three pullets were removed from the flock after laying the first five eggs.
[h] Three pullets were removed from the flock after paying the first five eggs.
[i] Four pullets were removed from the flock after laying the first five eggs.

were heavier than the females. The average weight of male chicks about forty-eight hours old was 30.41 grams, while that of the female was 28.08 grams, or 2.33 grams less than the male. As to the weekly increase in weight, the cockerels on an average were higher at all times during the experiment. The cockerels developed faster than the pullets. By examining the figures for each sex in table 2 it may be seen that the cockerels doubled their hatching weight by the second week and trebled it by the end of the third week. They reached one kilogram of weight at five and a half months of age. The pullets did not double their hatching weight

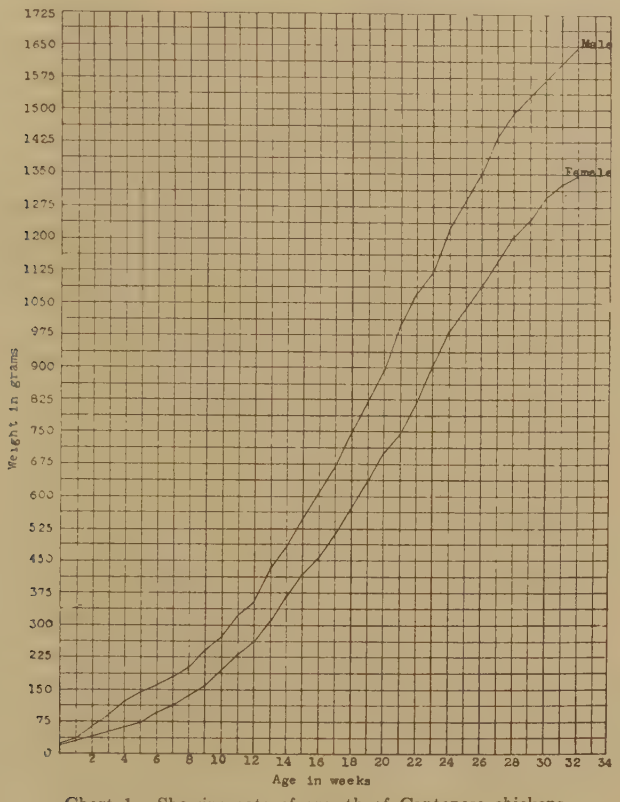

Chart 1.—Showing rate of growth of Cantonese chickens.

until they were four weeks old nor treble it until the fifth week. They reached one kilogram of weight at six and a half months of age, or one month later than the cockerels. At thirty-two weeks of age the cockerels weighed 1648.77 grams and the pullets weighed only 1338.3 grams, a difference of 310.47 grams in favor of the cockerels.

The rate of growth of both cockerels and pullets is graphically shown in chart I. These curves show that the rate of growth of the male and female chickens was uniform and regular. The Cantonese chicken grew

rapidly up to the twenty-seventh week, then the rate of growth gradually decreased. The curve of the cockerel's growth was constantly higher all the way through, being 92.4 per cent heavier than the pullets at four weeks of age, 43.9 per cent heavier at eight weeks, 35.1 per cent heavier at 12 weeks, 33.6 per cent heavier at 16 weeks, 27.0 per cent heavier at 20 weeks, 24.0 per cent heavier at 24 weeks, 22.8 per cent heavier at 28 weeks, and 23.1 per cent heavier at 32 weeks. While the cockerels grew more rapidly than the pullets, the relative discrepancy in size gradually diminished as they approached their mature weight.

Maturity. Table 3 shows the maturity of the pullets in days, the weight of each pullet when she laid her first egg, and the average weight of the first five eggs laid by each pullet. According to Hays and Bennett (1923), pullets are mature when they begin to reproduce. This was taken as a guide to determine the maturity of pullets in this experiment. There is, as yet, no guide to determine the maturity of cockerels, but inasmuch as they develop faster than the pullets it may be assumed that their age at maturity is approximately the same or even earlier than that of the pullets. Egg laying which is taken in this work as the guide for maturity, can be forced according to Lippincott (1921) by increasing the amount of protein, especially animal protein, of the feed given. This was avoided in this experiment. The feed remained in the same proportion throughout the work so that the pullets were neither forced nor delayed in maturing.

On an average the pullets under this experiment laid their first eggs when they were 212.7 days old, or about seven months. This is considerably less than the figure obtained by Lindayag (1918), which was 248.2 days, or 35.5 days less. The earliest laying pullet laid her first egg when she was only 128 days old and the latest one when she was 293 days old. As to their weights, the smallest weighed 850 grams and the heaviest, 2000 grams. The average weight of the first five eggs laid, 37.94 grams, is higher than the weight, 36.16 grams, for normal Cantonese eggs recorded by Lindayag (1918).

Table 4 shows the average weight of the first five eggs laid by each of the thirty-one pullets in this experiment. The individual weights of the eggs are not shown in the table, but it was found that the weights of the first eggs varied from 29 to 35 grams, the second, from 33.5 to 40 grams, the third, from 33 to 34 grams, the fourth, from 33 to 45 grams, and the fifth, from 33.5 to 45 grams. Upon examination of the table it may be seen that the eggs gradually increase in weight from the first to the fourth egg, but the fifth egg weighed 0.58 gram less than the fourth. Whether or not the eggs have attained their normal size at this time or continue to grow larger was not determined.

TABLE 3

Showing age and weight of hens when first egg was laid and average weight of first five eggs

BIRD NO.	AGE IN DAYS WHEN FIRST EGG WAS LAID	WEIGHT OF HEN WHEN FIRST EGG WAS LAID	AVERAGE WEIGHT OF FIRST FIVE EGGS LAID
		grams	*grams*
104	265	1350	39.0
106	237	1250	38.2
107	190	1256	38.8
108	208	1550	36.6
109	184	1325	34.1
117	213	1320	37.8
120	212	1300	37.2
124	223	1560	37.8
130	293	1400	38.2
135	194	1475	38.6
144	225	1250	39.8
146	203	1200	36.8
149	280	1250	38.0
152	242	1270	37.2
153	229	1075	39.6
163	183	1450	36.8
165	259	1500	39.2
169	233	1210	37.6
211	170	1200	38.2
218	176	1150	36.6
222	213	1500	39.8
225	203	1450	38.2
231	186	1100	35.8
232	227	2000	39.0
233	213	1600	41.0
235	203	1500	41.0
237	128	850	37.0
238	201	1180	35.2
242	201	1200	32.6
246	192	1400	39.4
251	208	1675	41.2
Average.....	212.7	1348.25	37.94
Range.....	128–293	850–2000	32.6–41.2

TABLE 4

Showing average weights of the first five eggs

	NO. OF EGGS	AVERAGE WEIGHT	INCREASE DECREASE IN WEIGHT
		grams	*grams*
First egg.....	31	32.16	——
Second egg...	31	35.75	+3.59
Third egg....	31	39.29	+3.54
Fourth egg...	31	40.79	+1.50
Fifth egg.....	31	40.21	—0.58

Mortality

Table 5 shows the weekly percentage of deaths. It shows that five chicks died of impaction of the crop, seventeen died of chicken pox, and thirteen were eaten by hawks. These last 13 deaths may be considered as accidental. The total deaths in all was 32.7 per cent. There were no deaths after the eighth week. This would seem to indicate that before this age the chicks were delicate and easily succumbed to unfavorable health conditions. Excluding the outbreak of chicken pox and the losses incurred through the hawks, the most precarious period in the life of these chicks was the first three or four weeks.

Post-mortem examinations of all the birds that died during the second and third weeks showed that the crops were very much distended, tightly packed with undigested feeds so that it is believed that death was caused by impacted crop. Chicken pox was responsible for the highest percentage of deaths during the fourth and fifth weeks. When the presence of the disease was discovered, all the sick and suspected chicks were isolated from the healthy ones and treatment to each was given at once. This helped a great deal in checking the disease.

TABLE 5

Showing percentage of mortality

AGE	NUMBER LIVING		NUMBER DIED	PERCENTAGE OF MORTALITY	REMARKS
	Beginning	End			
First week.....	107	107	0	0	
1 to 2 weeks..	107	104	3	2.8	3 died of impacted crop
2 to 3 weeks..	104	102	2	1.9	2 died of impacted crop
3 to 4 weeks..	102	102	0	0	
4 to 5 weeks..	102	92	10	9.3	10 died of chicken pox
5 to 6 weeks..	92	85	7	6.5	7 died of chicken pox
6 to 7 weeks..	85	75[a]	10	9.3	
7 to 8 weeks..	75	72[b]	3	2.8	
8 to 32 weeks..	72	72	0	0	

[a] 10 were stolen by hawks.
[b] 3 were stolen by hawks.

SUMMARY OF CONCLUSIONS

1. Male and female Cantonese chicks can not be distinguished from each other while they are very young. Males can be distinguished about the eighth week of age or sometimes a few weeks earlier by the large comb and wattles and the long pointed feathers at the saddle and back, while the females are distinguished by short feathers which are rounded at the end on the saddle and the back.

2. Female chicks have a tendency to develop their feathers earlier than the males.

3. Male chicks are naturally heavier and tend to grow faster than the females.

4. Under the conditions of the experiment, the Cantonese chicks were observed to grow rather slowly during the first few weeks of life, then very rapidly till the twenty-seventh week.

5. Young chicks were more susceptible to disease than the older ones.

6. On an average the pullets laid eggs when they were 212.7 days, or about seven months of age.

7. The first egg laid was smaller than the succeeding ones.

8. The male chicks had doubled their hatching weights when two weeks old, and the females when about four weeks old.

9. In this experiment the most critical period in the life of Cantonese chicks was during the first four weeks. After that they were raised to maturity with but little trouble.

LITERATURE CITED

HAYS, F. A., AND J. S. BENNETT. 1923. The correlation of sexual maturity to annual egg record. Poultry Science **2**: 205–206.

LINDAYAG, G. M. 1918. A comparative study of Cantonese and Native chickens. The Philippine Agriculturist and Forester **7**: 137–148.

LIPPINCOTT, W. A. 1921. Poultry production. 3rd ed., vii+541 p., 243 fig. Philadelphia: Lea and Febiger.

ABSTRACT

The rate of growth of Grade Rhode Island Red-Cantonese chickens. JORGE N. MENDOZA. (*Thesis presented for graduation, 1925, from the College of Agriculture, No. 234; Experiment Station contribution No. 393*).—The study was undertaken to compare the rate of growth of grade Rhode Island Red-Cantonese with the "pure" Rhode Island Red and the "pure" Cantonese chickens. In all, 43 Rhode Island Red, 63 Grade, and 170 Cantonese chickens were used. Of this number only 11 Rhode Island Red, 18 Grade, and 13 Cantonese were living at the close of the experiment. The chickens were given practically the same feed and treatment throughout the test. Their weights were taken every seven days from the time of hatching until the close of the experiment.

The results of the experiment show that:

1. The average initial weight of the Rhode Island Red chicks was 31.3 grams, Grade 27.3 grams, and Cantonese 25.6 grams.
2. The most delicate stage of the chick's life, in the three breeds, was the first eight weeks after incubation.
3. The Grade males grew faster and were heavier than either the Rhode Island Red or the Cantonese. At the age of 14 weeks the average weights were Rhode Island Red 655.0 grams, Grade 665.0 grams, and Cantonese 643.7 grams; and at 22 weeks 1,216.7 grams, 1,303.0 grams, and 1,136.1 grams in the same order.
4. To the age of 13 weeks the Grade females were heavier than the Rhode Island Red but lighter than the Cantonese. At the age of 14 weeks, however, the Grades were heavier than the Cantonese also. At that age the Rhode Island Red females weighed on the average of 550.0 grams, Grade 596.2 grams, and Cantonese 579 grams.
5. The Rhode Island Red pullets laid their first egg at the average age of 197 days, Grade 165 days, and Cantonese 175 days.

—*Abstract by Paterno V. Bayan.*

NOTE: HEMP PLANTS TO BE TRIED IN CANAL ZONE

A collection of approximately 1,400 selected plants of six of the leading varieties of abacá, or "Manila hemp," has been brought by H. T. Edwards, Bureau of Plant Industry, from the Province of Davao, Philippine Islands, to the Canal Zone and planted there. This achievement is the successful culmination of two years' effort on the part of the department to establish these plants in tropical regions other than the Philippine Islands.

Philippines produce world supply

Abacá, or "Manila hemp," is the raw material from which Manila rope is manufactured. The entire world supply of abacá, with the exception of a few hundred bales, is obtained from the Philippine Islands. The production of abacá is one of the leading industries of the Philippines, and the exports of this fiber in 1924 were nearly 400,000,000 pounds. The annual consumption of abacá in the United States is about 175,000,000 pounds.

The present production of abacá is barely sufficient to meet the world demand for this fiber, and there is a tendency toward a decrease, rather than an increase. Many of the abacá growers are now planting coconuts in fields that were formerly in abacá, as coconuts require less labor than abacá and there is a shortage of agricultural labor in the abacá provinces. Two different plant diseases that have appeared during recent years have either damaged or entirely destroyed the abacá crop on limited areas. It has been apparent, in view of these conditions, that an effort should be made to establish the abacá industry in tropical regions other than the Philippine Islands. Frequent attempts have been made in a number of different countries to grow abacá from seed, but the seedlings ordinarily do not come true to type and the results obtained from this work have been quite uniformly unsatisfactory. In 1923 a small shipment of abacá plants was made from Manila to the Canal Zone, and in 1924 a second shipment was made from Manila to Washington, D. C., but none of these plants survived the climatic changes and other hardships incident to the long journey.

During the early part of 1925, through the efforts of the office of traffic manager, arrangements were made for the routing of a freight steamer from the abacá-producing Province of Davao, in the southern part of the Philippine Islands, to the Canal Zone. It was believed that with this direct transportation it would be possible to successfully ship growing abacá plants from the Philippine Islands to the American Tropics.

Having made these arrangements for direct transportation during the months of July and August, 1925, this collection was loaded on the S. S. *Ethan Allen* at Malita, Davao, and brought by Mr. Edwards to the Canal Zone, arriving at Balboa on October 3.

Collection includes leading varieties

This collection of plants was obtained from five different plantations and includes the leading varieties of abacá in Davao Province. In order to determine the relative value of different kinds of propagating material, and also to ascertain the best methods of packing, the shipment included seed, buds, suckers, and rhizomes. The seed was shipped both in cold storage and packed in charcoal. Approximately 500 buds, suckers, and

rhizomes were planted either in soil or sphagnum, about 100 suckers and rhizomes were packed in charcoal, and between 800 and 900 rhizomes were wrapped in paper and excelsior and shipped in crates.

Of the total shipment of 1,438 plants, including buds, suckers, and rhizomes, 1,052 plants, or 73.2 per cent, were alive, and 769 plants, or 53.5 per cent, were in good condition when the shipment arrived at its destination.

Some of the plants in this shipment have been planted temporarily at a quarantine station situated about 9 miles from the town of Bocas del Toro on Columbus Island, near the eastern coast of the Republic of Panama. The remainder has been placed in the Plant Introduction Gardens at Summit, Canal Zone.

With the possible exception of an occasional plant in greenhouse collections, these plants are believed to be the only abacá plants, other than seedlings, that are now growing in tropical America.

—*The Official Record*, December 9, 1925, (U. S. Dept. Agric.)

NOTE: NEMATODE WORMS

Eelworms, or Nematodes, very harmful to pineapples and sugar in Hawaii, says Muir. The remarks equally applicable to the Philippines, says Dean Baker.

Nematodes, next to insects, are the most numerous of all the divisions of animals, according to Frederick Muir, of the H. S. P. A. Experiment Station. They are also the most widely distributed. You will find nematodes from the Arctic to the Antarctic, says Muir, and you will find them high up in the mountains and down deep in both fresh and salt water. There is hardly any group of animals in the world in which you do not find nematodes as parasites. There are about 20 species of nematodes parasitic on man. Fishes are very heavily infected by nematodes, as are also snakes, lizards and birds. Among the invertebrate animals, as the insects, nematodes are very commonly parasitic, but in spite of all this the study of nematodes is so little advanced that one may say that we are just on the threshold.

A nematode is just a little wriggling worm. They vary in length from two or three inches, which is the size of some of the larger parasitic ones, to a millimeter.

It is very fortunate for agriculture that there are only a comparatively few kinds of nematodes that have to be dealt with, only those which possess a certain type of mouth which enables them to feed on plant roots.

This mouth consists of several lip-like structures which may be attached closely to a root and a spear-like structure inside the pharynx which is used to lacerate the plant tissues and make the sap run out. This sap is then

sucked in by a pump arrangement. It is only such nematodes which can be harmful directly, but indirectly there may be others which are harmful in conveying diseases.

It appears likely that the problem of root rot in sugar cane is very closely related to the same disease of pineapple. The same factors that are recognized in the cane root rot or Lahaina disease, are being recognized today in the disease of the pineapple. I do not mean that the same species of fungi or nematodes are to blame in both cases, but similar conditions seem to prevail in both of these troubles.

We are now learning what is taking place in our sugar cane roots and also in the pineapple roots as far as nematodes are concerned. From a very cursory examination of our pineapple roots and soil I find that at least four species of nematodes are present and can be considered as parasites. That is, they enter into the root itself and live there. There are also certain other species which live in the soil. They don't enter into the root itself, but they pierce it with their spear and suck the juices from the root. They are also harmful from the mechanical point of view, and may be the means of giving entrance to disease organisms.

—*The Extension Letter No. 220,*
(University of Hawaii).

He who knows not, and knows not that he knows not, is a fool; shun him.

He who knows not and knows that he knows not, is a child; teach him.

He who knows and knows not that he knows, is asleep; wake him.

He who knows and knows that he knows is wise; follow him.

—*Persian Proverb.*

EXCHANGE NOTES

Every community should have its fair. Such is my conclusion after visiting a dozen community fairs last summer. They stimulate local interest, encourage better farming methods and bring the town and country closer together. Local breeders of good stock or poultry or growers of exceptionally good crops may be induced to make their first exhibit and, finding the merit of what they are producing, become state fair exhibitors. By direct comparison the farmers learn whether or not their breeding program is producing the right type. The fair is a good means of advertising, both for the farmer and for the merchant in the town where the fair is held. It brings out the best in the community.

But the fair must be clean. The objectionable features of the carnival type of faking fairs has prejudiced many communities against a fair of any kind. There must be no fakes, no tricks, it must not be for profit. It must needs be a co-operative affair in which the farmers themselves co-operate and as a group co-operate with the townspeople.

—*Successful Farming* (Iowa).

The influence and usefulness of farm boys as citizens will be in a ratio as they stand for what is right. To take and maintain this stand it often will be necessary for them to place themselves against the crowd and against the popular tendency.

Only the man who stands alone when the crowd is wrong is fit to be their leader in their return to right. History shows that it is from such men the leaders for good in a community always come.—Vice-President Charles G. Dawes.

—*The Prairie Farmer* (Illinois).

In the course of his foreword to the State Forest Service bulletin "Forest and Timber Insects in New Zealand," Mr. David Miller remarks: "In the past, forest entomology has been neglected in New Zealand, and although at present there are insufficient data available, except in some isolated cases, from which a computation can be made of the actual loss due to insects, there can be no doubt that a very appreciable amount of depreciation takes place, the full extent of which will be recognized, and a great deal of it prevented, only when a better knowledge of the forest and timber insects in the Dominion is at hand. A review of the forest history of such countries as Europe and North America will reveal that the annual loss directly due

to insect depredation is enormous, and we have ample evidence that the same condition prevails, and has prevailed, in this country both in our native forests and exotic plantations."

—*Journal of Agriculture* (New Zealand).

The question of making an efficient motor fuel in the tropics, where imported spirit is expensive, is at present attracting considerable attention. Various materials have been suggested, and in some cases tried, as a source of power alcohol, such as starch-containing roots, and cellulosic residues from the sugar and other industries, but one of the most valuable appears to be the sap which may be collected from the flowering shoots of the Nipa palm of the Far East. Considerable work has been done in the Philippine Islands in ascertaining the suitability of this palm for the production of alcohol and quite recently an experimental plant has been erected in the State of North Borneo. The plant is being run under the direction of the local Department of Agriculture and an account of the results of the first year's working, based on a memorandum supplied by the British North Borneo Company, is given in the current number (XXIII, No. 2) of the "Bulletin of the Imperial Institute," published by Mr. John Murray.

There are about 300,000 acres of Nipa palm in North Borneo, occurring in nearly solid stands of 5,000 acres or more. The sap flows for only six months in the year, but it is estimated that during this period 900,000,000 gallons of sap, capable of producing nearly 60,000,000 gallons of alcohol, could be obtained. The results of the first year's working of the experimental plant came up to expectations in every way. The still was only capable of producing 100 gallons of alcohol per working day of 12 hours, and the costs of running such a small plant were naturally somewhat high, but it is shown that a permanent plant producing not less than 1,000 gallons per day should prove a commercial success. Estimates are quoted in the article of the cost of production for plants of various capacities. For a plant capable of producing 2,000 gallons per day of 12 hours the capital required is estimated at about £26,000, and the profits on the spirit delivered in Singapore or Hong Kong would be equivalent to a dividend of 10 per cent. on the capital. An 8,000 gallon plant run for 24 hours per day would require a capital of about £122,000, and this, it is estimated, would yield profits equivalent to 30 per cent. on the capital.

—*Agricultural Journal* (India).

A legume in the rotation at the Kansas agricultural college increased the wheat yield 6.5 bushels per acre and raised the protein content of the wheat 1.7 per cent.

—*Successful Farming* (Iowa).

COLLEGE AND ALUMNI NOTES

President Palma addressed the students at the Second Convocation of the Student Body. He spoke upon the value to the country of our graduates and expressed the opinion that from this college should come leaders in national as well as local affairs.

Colonel Carmi Thompson, the special envoy sent by President Coolidge to the Philippines to look over the agricultural and industrial conditions, visited the College the last week in July. With Colonel Thompson were President Palma and representatives of several leading United States journals, Manila press representatives, and government officials, making a party numbering over sixty. Colonel Thompson was enthusiastic in praise of what has been accomplished at the College, and expressed himself emphatically on the need of more liberal funds for the institution.

Dr. B. H. Crocheron, Director of Agricultural Extension, University of California and Dr. F. C. Gearhart, owner of the Santa Mesa Dairy, were College visitors in July.

Dr. Benjamin Schwartz, formerly on the faculty of the College of Veterinary Science, now with the Bureau of Plant Industry, Washington, D. C., is using material secured while here in several of his numerous papers. Four articles appearing in the *Journal of Parasitology* in 1924, dealt with parasites in both man and animals found in the Philippines.

Prof. C. P. Johnson of the Rural Engineering Department resigned. He returned to the United States in July.

A delightful *lechonada* was given by the Good Fellows Sporting Club in honor of Professor Anastacio L. Teodoro, one of its active members, at the home of Doctor Espino on August 8, 1926. An interesting feature of the day was tennis tournament in which the members of the club took an active part.

Professor Teodoro, a newly appointed pensionado, left for the United States, August 11, on the *President Lincoln*. He will study in the University of Nebraska, specializing in Agriculturing Engineering.

New books and other publications added to the Library, College of Agriculture, between May 1, and July 31, 1926.

Atkins, W. R. G.
Some recent researches in plant physiology. 1916.

Baehr, V. B.
Recherches sur la maturation des seufs pàrthenogenetiques dans l'aphis palmae. 1920.
Baston, E. S.
Elements of botany. 1887.
Birmingham
Catalogue of the Shakespeare memorial library. 1866.

Carters, H. R.
Rope, twine, and thread making. 1924.
Churchman, A.
The Bible and the scriptural ground of divorce forgery. 1921.
Conn, H. J.
Biological stains; a hand-book on the nature and uses of the dyes employed in the biological laboratory. 1925.

Davis, W. M.
Practical exercises in physical geography. 1908.

Frets, G. P.
Heredity of headform in man. 1921.

Goulding, Ernest
Cotton and other vegetable fibers. 1919.
Haithsox, H. C.
Man and his education. 1919.
Harris & Allen (ed.)
Webster's new international dictionary. Merrian Series. Springfield. 1925.
Hines, C. W.
Cane production and sugar manufacture in the Philippine Islands. 1919.

Juritz, C. F.
Agricultural soils of the Cape Province. 1907.

Lepperhoff, B.
Die flechterei. 1922.
Lesne, P.
Les coleopteres bostrychides de l'Afrique tropicale Française. 1924.
Lotsy, J. P.
Evolution by means of hybridization. 1916.

Masters, M. T.
Pflanzen—teratologie. 1886.
Migula, W.
Die desmidiazeen. 1911.
Mitsubishi Goshi Kaisha
An outline of the Mitsubishi enterprises. 1926.
Mullins, J. P.
Catalogue of the reference library, Birmingham Free Libraries. 1883–1890.

National Research Council
International critical tables of numerical data; physics, chemistry and technology. 1926.
New South Wales
New South Wales statistical register for 1923–1924.

Pellett, F.
American honey plants. 1923.
Petrunkewitsch, A.
Künstliche parthenogenese. 1904.
Powell, W.
A catalogue of the Birmingham collection including printed books and pamphlets, manuscripts, maps, etc. 1918.

Reed, G. R.
The laws of heredity. 1910.
Roberts, E.
Plant and animal improvement. 1925.
Rome. Int. Inst. of Agri.
International yearbook of agricultural statistics. 1925.

Schilling, Ernst
Die fasserstoffe der pflanzenreiches. 1924.
Shaw, C. A.
An index to the Shakespeare memorial library. 1903.
Smiles, S.
Self-help.
Society of Chemical Industry
Annual report on the progress of chemistry. 1922–1925.
The Holy Bible, containing the old and new testament with cyclopedic concordance and maps.

U. S. D. A. Bureau of Soils
Field operations of the Bureau of Soils. 1925.

Van Leenwen-reijnvaan, J.
The zoocicidie of the Netherlands East Indies. 1920.
Van Slyke, L. L.
Modern methods of testing milk and milk products. 1916.

Waters, H. J. and King, F. G.
Animal husbandry. 1925.
Williams, W. S.
The problems of the unemployed. 1917.
Winklers, H.
Verbreitung, und ursache der parthenogenesis in pflanzen und tierreichie. 1920.

Yule, G. U.
Theory of statistics. 1924.